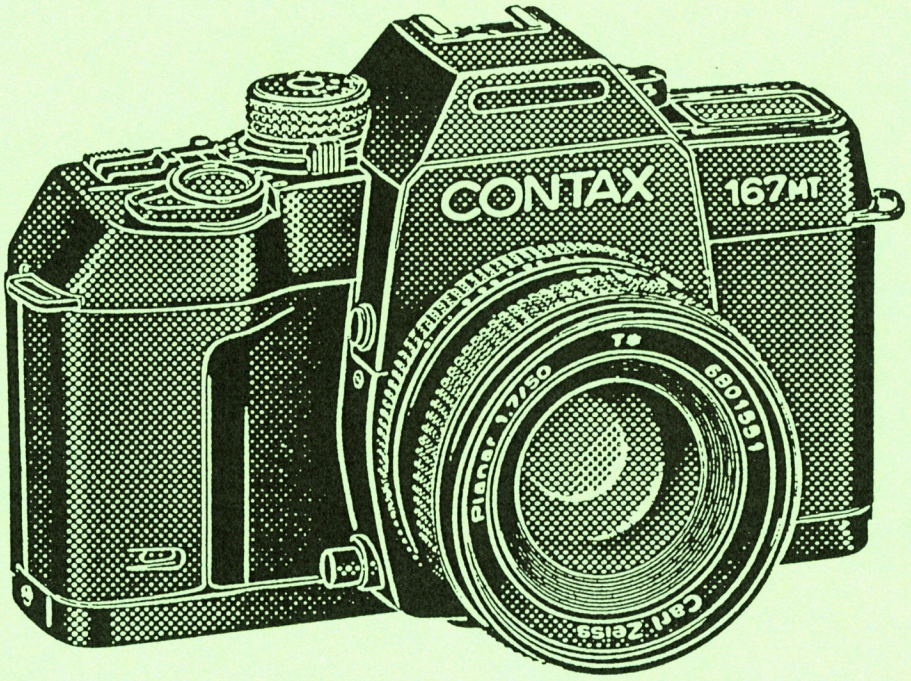
CONTAX



167MT

REPAIR MANUAL

KYOCERA CORPORATION
Optical Equipments Division, Service Dept.
Printed in Japan 870710

CONTENTS

A Operation Manual

CONTAX 167 MT Specifications

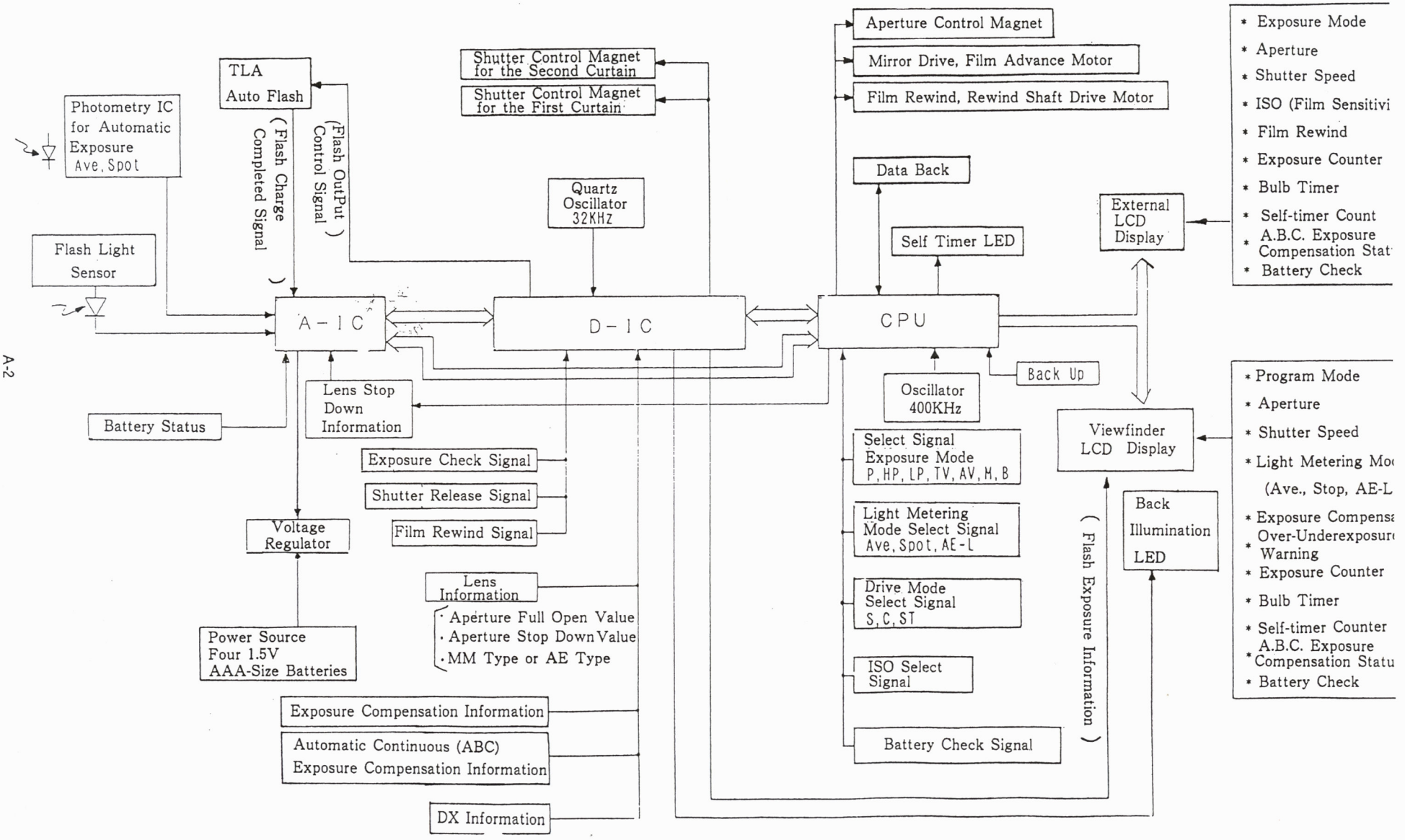
Type: 35mm focal-plane shutter, auto/manual exposure SLR.
Picture Size: 24 × 36mm.
Lens Mount: Contax/Yashica mount.
Shutter: Electronic quartz-controlled, vertical-travel, metal focal-plane shutter.
Shutter Speeds: 16 sec. to 1/4000 sec. in all modes. "Bulb" also available in Manual mode.
Self-timer: Quartz-controlled electronic self-timer with 10-sec. delay; LED indicator (blinks fast for 2 seconds after the self-timer starts and again for 2 seconds before the shutter is released); exposure counter indicates remaining time.
Shutter Release: Electromagnetic release with cable switch socket.
Exposure Control: Exposure modes are set by pressing the Mode button and using the Operation Control.
Exposure Modes: (1) Standard Program auto exposure, (2) High-speed Program auto exposure, (3) Low-speed Program auto exposure, (4) Shutter-priority auto exposure, (5) Aperture-priority auto exposure, (6) Manual exposure, (7) Programmed TTL auto exposure, (8) Aperture-priority TTL auto flash, (9) Manual mode auto flash, (10) Manual flash exposure.
Metering System: TTL full-aperture, center-weighted metering/ TTL full-aperture spot metering (spot metering LED turns on in viewfinder), TTL center-weighted direct metering with TLA System flash units, SPD (Silicon Photo Diode) cells.
Metering Range: EV0 to EV20 for full-aperture center-weighted metering. (ISO 100, f/1.4 lens).
Film Speed Range: ISO 25 ~ 5000 in DX auto mode. ISO 6 ~ 6400 in manual mode.
Film speed is displayed on the external display panel when the ISO button is pressed.
Flash Synchronization: X-sync only. Shutter speed is automatically set to 1/125 sec. in TTL auto flash mode with dedicated flash. Synchronizes at 1/125 sec. or slower in manual flash mode. Sync terminal provided.
AE Lock: Exposure values are stored in memory.
Exposure Compensation: ±2 EV (1/3 EV click stops). Automatic Bracketing Control. (±0.5EV or ±1.0EV in the AV mode, ±1.0EV or ±1.5EV in the Program and TV modes.)
Viewfinder: Pentaprism eye-level finder with long eyepoint. 95% field-of-view, 0.82X magnification with 50mm lens focused at infinity.
Focusing Screen: Standard horizontal split-image/microprism collar. Interchangeable screens are available.
Viewfinder Display: Display appears for 16 sec. after the shutter release is partially depressed. Also when the ISO or Mode buttons are pressed. The LCDs indicate exposure compensation, shutter speed, aperture, exposure counter (also used for Automatic Bracketing Control). LCDs are used for the spot metering and program mode. An LED is used for the flash-ready symbol.
External Display Panel: Displays appear for 16 sec. after the shutter release is partially depressed. Also when the ISO and Mode buttons are pressed. LCDs indicate exposure mode, shutter speed, aperture, film speed, number of exposures (also used as a timer for the self-timer and "Bulb" exposures), film rewind symbol and battery checker.
Film Advance: Automatic micro-motor film loading (to frame "01") and film advance.
Film Rewind: Automatic rewinding with Rewind Motor. Approx. 10 sec. for 36 exposure film* (*Based on testing undertaken at Kyocera Corporation.) The motor stops automatically when the film is rewound. Film can be rewound in mid-roll.
Exposure Counter: Automatic resetting, accumulative type counters which count up to 39 frames appear in both the external display panel and viewfinder display. The shutter operates at 1/125 sec. until the film is advanced to frame "01."
Accessory Shoe: Direct X-sync hot-shoe (with TLA flash contact).
Shooting Speed: Single-frame, continuous and self-timer operation available. Continuous operation at up to 3 frames per second.
Camera Back: The detachable back is opened with the camera back release lever. Includes a film check window and film transport signal.
Power Source: Four 1.5V AAA-size batteries.
Battery Check: Press the ISO and Mode buttons at the same time.
Battery Capacity: AAA alkaline batteries- approx. 50 rolls. (24-exposure 35mm films* at normal temperatures.) *Based on testing undertaken at Kyocera Corporation.
Others: Aperture stop-down button, contacts for data back.
Dimensions: 149(W) × 91.5(H) × 51.5(D) mm. (5-7/8 × 3-5/8 × 2-1/16 in.)
Weight: 620 grams, without batteries. (1.37 lbs.)
Optional Accessories: •Battery Holder P-5 (Contains four AA batteries and attaches to camera bottom.) •Power Pack P-6 (Used with Battery Holder P-5) •F3 Eye cup •Standard Case C-31, Front Covers C312, C313 •Camera + Data Back Case C-32, Front Covers C312, C313.

CONTAX DATA BACK D-7 Specifications

Type: LCD (Liquid Crystal Display) projection data back with built-in Quartz Timing device. **Multi-Function Type.**
Data Characters: 7-segment and dot-type liquid crystal alpha-numerics and symbols. Up to 10 digits.
Data Location: Lower right corner of frame.
Recording Modes: (1) Year/month/day+message; (2) Hour/minute+message; (3) Message; (4) Year/month/day+hour/minute; (5) Off.[Both 12-hr. ("A") and 24-hr. ("P") clock functions included.]
Memory Function: Five messages of up to 10 characters each can be stored in memory.
Intervalometer Function: Starting times in months, days, hours and minutes. Intervals of 1 sec.—Approx. 100 hours. From 1 to 99 exposures.
Long-time Exposure Function: Settings from 1 sec. to approx. 100 hours.
Mode Selection: Push button operation.
Recording Method: Automatic (confirmation indicator included).
Film Speed Setting: Automatic (DX).
Camera Connection: Cordless.
Continuous Operation: Connected to the built-in motor-drive of the camera.
Quartz Clock: Digital Quartz, automatically compensates for long months, leap years. Displays year, month, day, hour, minute.
Power Supply: 6V (two 3V CR2025 lithium batteries).
Dimensions: 142.5(W) × 55(H) × 20.5(D)mm. (5-5/8 × 2-3/16 × 13/16 in.)
Weight: 93 grams, without batteries. (3.3 ozs.)

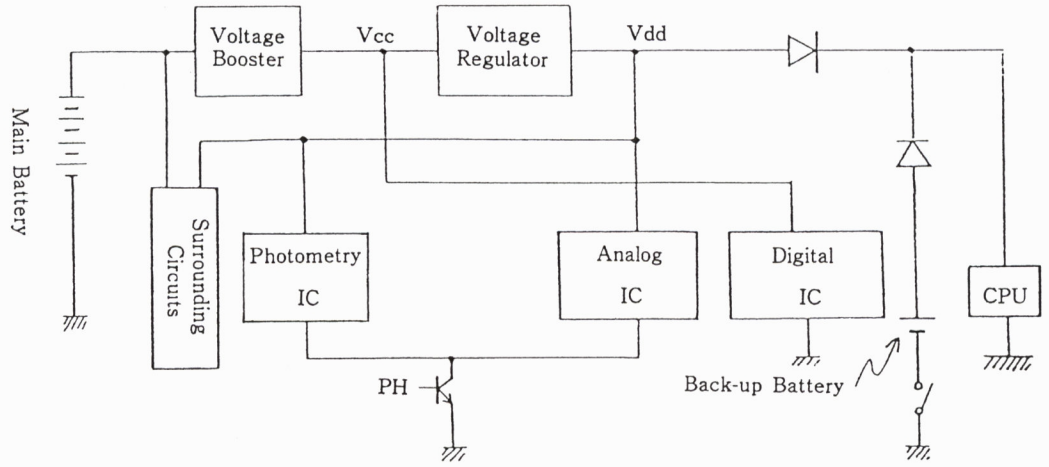
**Specifications and exterior design subject to change without notice.*

Electrical Circuit Block Diagram



General Description

(1) Electronics



* The circuits are powered by either VCC (boosted) or VDD (regulated) voltage.

VCC : 4.2V approx.-Battery Voltage

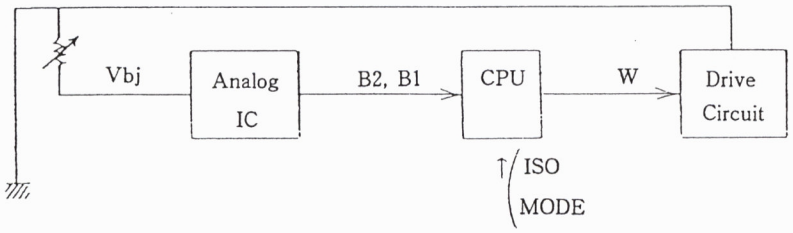
VDD : 3.6V approx.

* PH (Power Hold)

When the main switch is turned off, or sixteen seconds after the system becomes inactive, the analog circuits will be turned off. At the same time, the CPU will stop to operate (displays are turned off). In this state it is the digital oscillator that remains active.

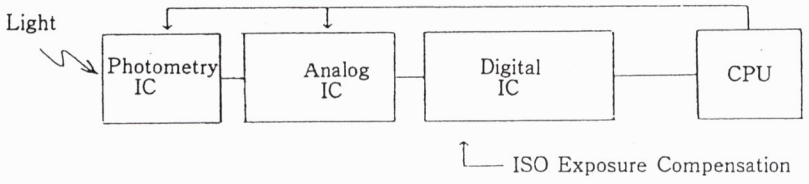
* When the main batteries are removed, the back-up battery will keep the CPU memory alive.

(2) Battery Check Circuit



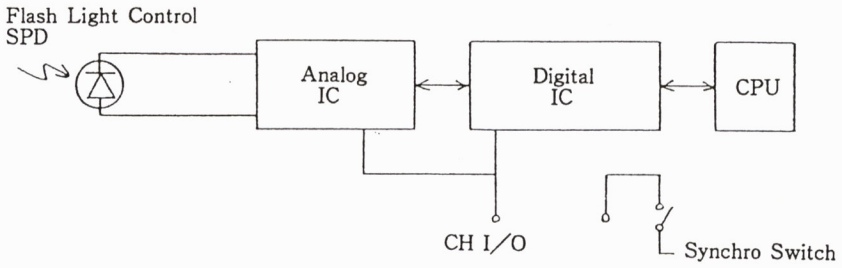
When the ISO and Mode Switch are pressed at the same time, the drive motor is turned on momentarly (winding direction). The Analog IC detects the voltage drop and releases the information to the CPU as the battery status signal. Depending on the status, the CPU determines the mode of LCD display : constant or blink (2HZ or 4HZ).

(3) Light Metering Circuit



The Photometry IC measures the amount of incoming light (either in spot or average mode) and converts it into voltage which is then fed to the Analog IC. The A/D conversion is performed by the Digital IC and the light data are sent to the CPU. Other factors which affect exposure (F-Stop, Open Aperture Value, ISO Speed, etc.) are also processed by the Digital IC before they are sent to the CPU. The CPU then calculates and returns the shutter speed data back to the Digital IC which also controls the Shutter Magnet.

(4) Flash Light Control Circuit



When the Flash is charged, the status of the CH I/O becomes high and the system enters the Flash mode. When the shutter release button is pressed and the synchro switch is closed, the Flash begins to flash. The light is sensed by the Flash Light Control SPD whose output is integrated and compared to the standard voltage which varies according to the ISO setting. When the integrated voltage reaches a certain voltage, the flash light is turned off.

(5) Shutter Control

The first and the second curtains of the shutter are controlled independently by two magnets. The CPU sends shutter speed data and control signals to the Digital IC which in turn drives the magnets.

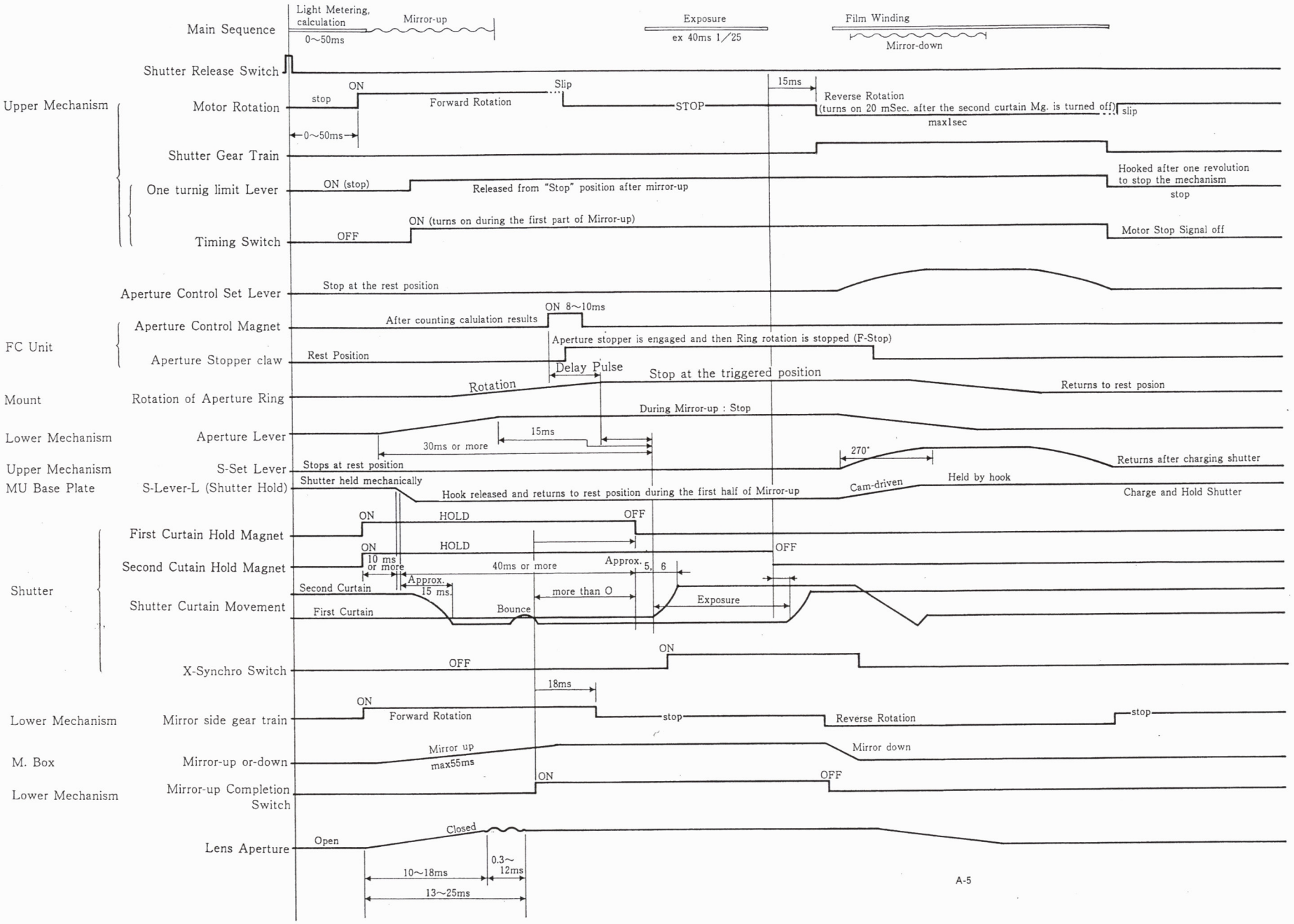
(6) Motor Drive Circuit

The two motors are driven independently by two drive circuits in bridge configuration which can turn the motors in either direction.

The CPU signal controls activation of the mirror (mirror up), film winding and rewinding, etc.

(7) F-Stop Control (Aperture Stop Control)

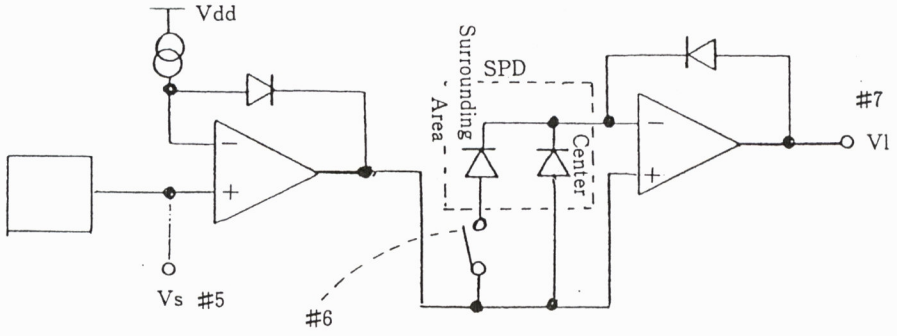
The amount aperture movement is measured by the Analog IC using an encoder whose output pulses are treated by the IC before they are sent to the CPU. The CPU then counts the number of the pulses in a manner similar to that described in (3) Light Metering Circuit. When the count reaches a certain predetermined value, the aperture magnet is activated to stop the aperture movement.


Main Sequence
Light Metering, calculation
0~50ms
Mirror-up
Exposure
ex 40ms 1/25
Film Winding
Mirror-down
Shutter Release Switch
Upper Mechanism
Motor Rotation
stop
ON
Forward Rotation
Slip
STOP
15ms
Reverse Rotation
(turns on 20 mSec. after the second curtain Mg. is turned off)
slip
max1sec
0~50ms
Shutter Gear Train
One turnig limit Lever
ON (stop)
Released from "Stop" position after mirror-up
Hooked after one revolution to stop the mechanism
stop
Timing Switch
OFF
ON (turns on during the first part of Mirror-up)
Motor Stop Signal off
Aperture Control Set Lever
Stop at the rest position
FC Unit
Aperture Control Magnet
After counting calulation results
ON 8~10ms
Aperture Stopper claw
Rest Position
Aperture stopper is engaged and then Ring rotation is stopped (F-Stop)
Delay Pulse
Mount
Rotation of Aperture Ring
Rotation
Stop at the triggered position
Returns to rest posion
During Mirror-up : Stop
Lower Mechanism
Aperture Lever
15ms
30ms or more
Upper Mechanism
S-Set Lever
Stops at rest position
270°
Returns after charging shutter
MU Base Plate
S-Lever-L (Shutter Hold)
Shutter held mechanically
Hook released and returns to rest position during the first half of Mirror-up
Cam-driven
Held by hook
Charge and Hold Shutter
Shutter
First Curtain Hold Magnet
ON
HOLD
OFF
Second Cutain Hold Magnet
10 ms or more
40ms or more
Approx. 5, 6
Approx. 15 ms
Second Curtain
Shutter Curtain Movement
First Curtain
Bounce
more than 0
Exposure
X-Synchro Switch
18ms
Lower Mechanism
Mirror side gear train
Forward Rotation
stop
Reverse Rotation
M. Box
Mirror-up or-down
Mirror up
max55ms
Mirror down
Lower Mechanism
Mirror-up Completion Switch
Lens Aperture
Open
Closed
0.3~12ms
10~18ms
13~25ms

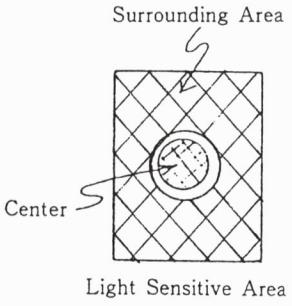
I. Photometry IC

(A) Terminal Assignments for Photometry IC

Pin #	Description
1. VSS	Negative (−) Supply Voltage
3. Vdd	Positive (+) Supply Voltage
5. Vs	Standard Voltage Output
6. SWSC	Ave./Spot Light Metering Select Input
7. VL	Light Metering Signal Output
8. T.P.	Offset Adjustment
9. MOS IN	Same as above
12. NULL−	Offset Adjustment
13. NULL+	Offset Adjustment



(B) Circuit Description



① Photo cell (photo diode) and pre-amplifiers are integrated in one package. The IC generates the output voltage (VL) for the Analog-IC according to the incomming light intensity. The photo diodes are assigned for light detection of either the center area or the surrouding area whose proportion is:
Center Area : Surrounding Area = 1 : 4

② Pin #6 : When this input is left open (H), the internal switch is turned on and it functions in the averaged light measuring mode.
Averaged light Measuring (Total area light metering) = Center Area + Surrouding Area.
When the input is low, only the center area is measured in the spot metering mode.

③ Vs : Standard Voltage ---Approx. 1.22 Volts
(regulated voltage output)

④ Output voltage is proportinal to brightness.
The voltage varies 18mV when the brightness is increased twice or decreased by half.

⑤ Selectable "Spot" or "Average" measuring depends on the status of the IC pin #6.
The pin is connected to the Analog IC #41.
Photometry IC #6 : "H"→Averaged light Measuring
: "L"→ spot Metering

Output level in spot meteuring is 2EV (36mV) lower than that of the averaged light measuring.

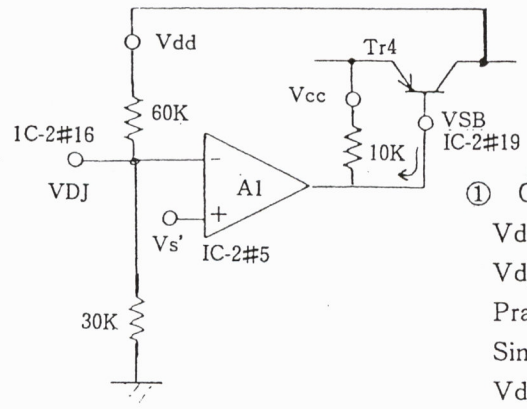
Ⅱ. Analog IC

(A) Terminal Assignments for Analog IC

Pin #	Description
1. Vr	Standard Voltage Output
2. Vjr	Vr Voltage Adjustment
3. Pin	Encoder Input
4. Puls	Encoder Output
5. Vs	Analog Ground
6. Vbj	Battery Check Voltage Adjustmet Input
7. Vbc	Battery Check Adjustment Input
8. B1	Battery Check Output
9. B2	Battery Check Output
15. Dcc	Voltage Booster Output
16. Vdj	Vdd Control Input (regulator)
17. Vss	Negative (−) Supply Voltage
18. Vcc	Positive (+) Supply Voltage
19. Vsb	Vdd Output Control
20. Vdd	Positve (+) Supply Voltage
21. CHS	Flash light control Output
22. Vs	Analog Ground
23. Vj2	Vth Adjustment
24. Vth	Flash light control Standard Voltage
25. Pdk	Flash light control Photo Diode Input
26. Pdc	Flash light control Comparator Input
27. $\overline{cs}$	Chip Select
28~32.	ISO Code Input
33. CMD	D/A Drive Clock Input
34. $\overline{CHC}$	Flash light control Integration Start Input
35. $\overline{sp}$	Dual Integration Sampling Input
36. LAD	A/D Converter Ouptut
37. co	Dual Integration Output
38. CI	Dual Integration Input
39. Vss	Negative Supply Voltage
40. VL	Light Measuring Input
41. Swsc	Vave, Vspot Light metering select input
42. Vave	Average exposure adjustment Input
43. Vspot	Spot exposure adjustment Input
44. Vs	Analog Ground

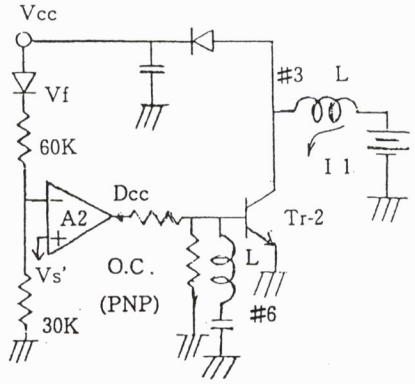
(B) Analog IC Circuit Description

(1) Voltage Regulator



① Output of the Vdd pin is controlled to be 3×Vs'+Vf
Vdd reduces as Vsb decreases (Tr4 turns ON).
Vdj=Vs'=1/3Vdd Vdd=3Vs'
Practically, Vs'=Vs.
Since a diode is placed in series to Vdd,
Vdd=3Vs+Vf (0.6V) ·····Approx. 4.1~4.5V.

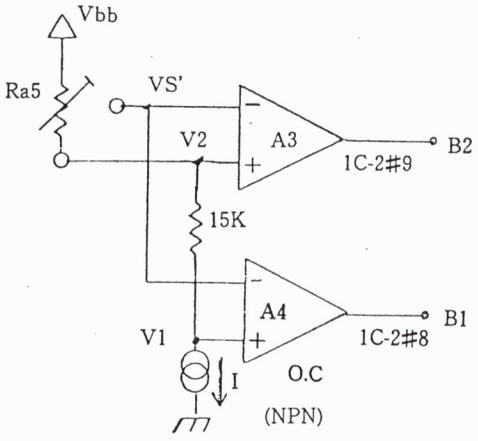
(2) Voltage booster



① Vcc is controlled to be 3xVs'+Vf
When Vcc goes low, Dcc becomes high, and then Tr-2 is turned ON.
When the current I1 draws, the counter voltage appears at the base.
The base voltage of the transistor decreases and the I 1 increases → TR-2 will saturate.
I 1 becomes constant and the counter voltage decreases → TR-2 becomes active → Repeat the sequence.

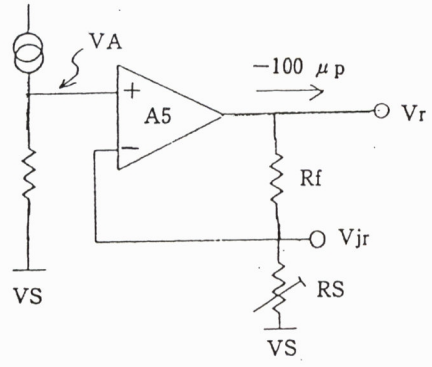
Vcc=3Vs'+Vf ·····Approx. 4.7~5.2V.
Due to the presence of a diode, the voltage will be increased by Vf.
Vccl=3Vs'+Vf+VF ·····Approx. 3.66V

(3) Battery Check Circuit



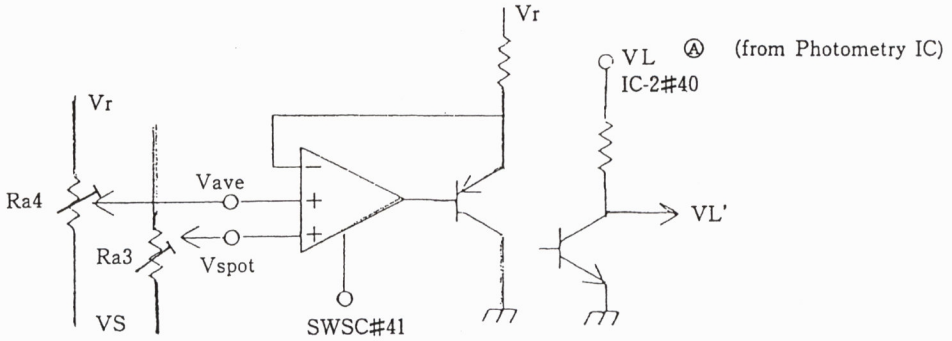
① When Vbb (Vbj) becomes lower than Vs', the terminals of B1 and B2 will be turned ON (L).
V1 is lower than V2 by about 540mV.
If the Vbj is sufficiently high, the output of Analog IC terminals of IC's #8 and #9 are turned OFF (H). As the Vbj decreases, the output of the Analog IC#8 is first turned ON (L). When the Vbj further decreases so that V2 is lower than Vs', the IC#9 turns its output ON (L).

(4) Vr : Standard Voltage Circuit



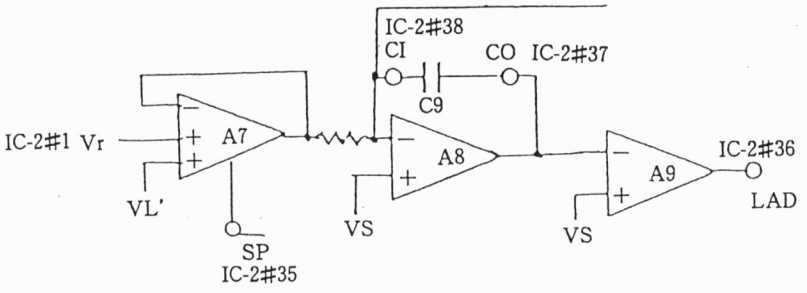
① The standard voltage Vr is generated from the Vs by this voltage regulator circuit. (The circuit is a part of the Photometry IC whose output is referenced by the Analog IC, etc.)
Vr=Va (1+Rf/Rs)
The Vr is adjusted to be 720mV with the potentiometer Rs.
Thermometer characteristics is +2.4lmV/°C.

(5) Light Metering Adjustment Circuit

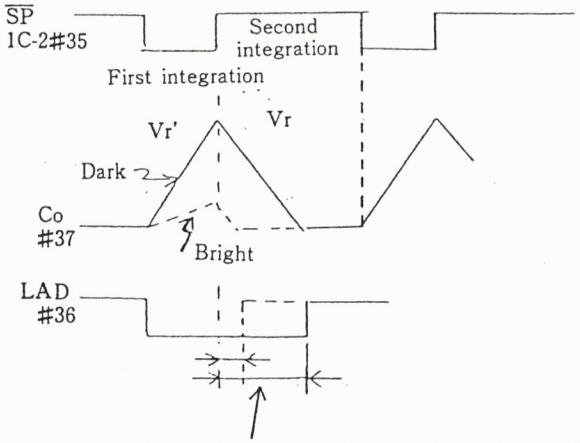


① The status of the Pin #41 (swsc) determines the operation mode of either Averaged light Measuring or Spot Metering whose adjustment can be made independently.

(6) A/D Converter



① The signal applied at Pin #35 selects either one of the input signals VL' (brightness dependent voltage) or Vr. The capacitor is charged or discharged for digitization of the signal. The output appears at Pin #36.

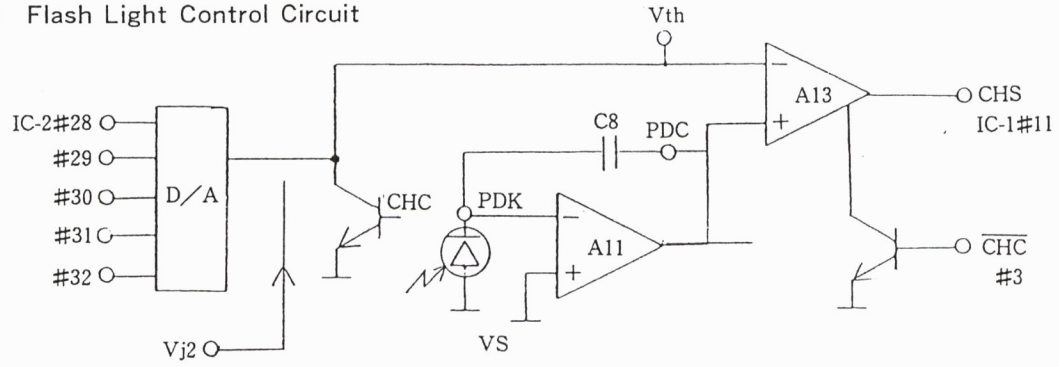


Proportional to brightness : short when bright, long when dark

Pin #35 : "L" selects VL', integration of the brightness signal.
"H" selects Vr, discharge of Vr.
The input of the A/D converter is high when the sensed brightness level is low. Therefore, the slope of the first integration curve applied to the integration capacitor is large when it is dark and small when it is bright. The results of the first integration determines the discharge time of the second integration whose discharge curve is constant. The discharge time is short when it is bright and long when it is dark, affecting the light measuring output (value of the LAD) which appears at Pin #36.

② Predetermined Value
Pin #35 : First integration 9.77 (9.765625) mSec.

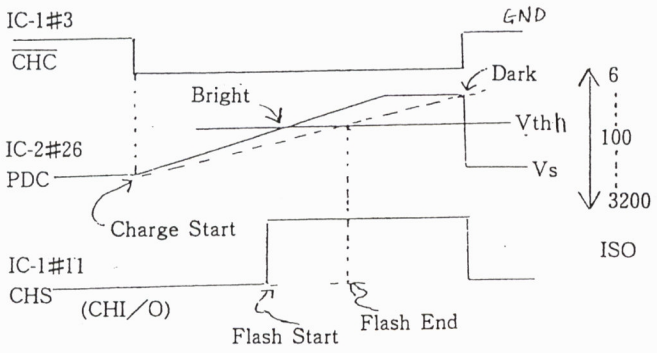
(7) Flash Light Control Circuit



① The codes D4~D0 (A-IC #28~32) determine the level of Vth (which varies according to the selected ISO setting).
The adjustment is made with the Vj2. (The code is of ISO, not of DX)

② When the flash is activated, the Flash start signal (D-IC #3) and the reflected Flash light are fed to the circuit.

③ The capacitor (C8 470pF) will be charged as the reflected light is sensed. The voltage across the capacitor appears at A-IC #26 and when it reaches the Vth, the Flash stop signal is turned on (D-IC #11 turns high) and cuts off the Flash light. (The voltage does not appear at Vth until the Flash start signal is pulled down to the ground.)

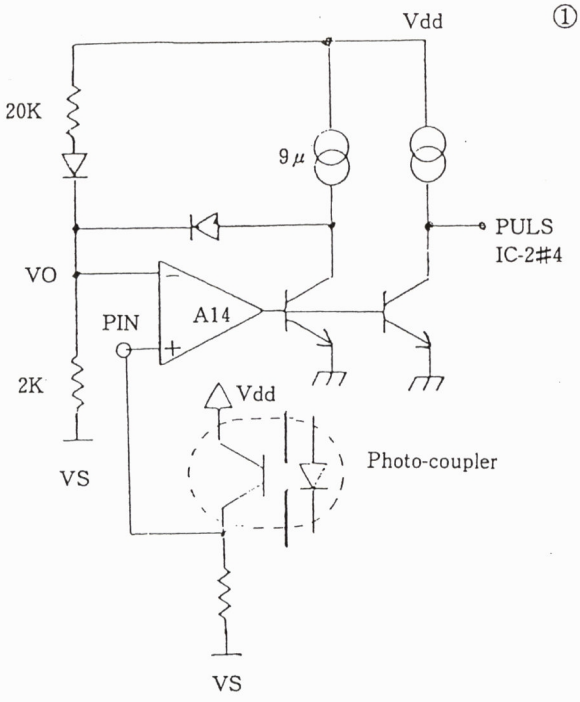


Standard Voltage of Flash Light Control : Vth 160mV - ISO 100

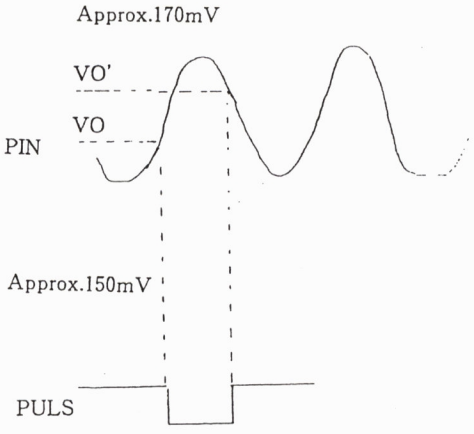
※ When the ISO setting is stepped up by one stage (ISO 200), the level of the Vth is reduced by half.

When the ISO setting is stepped down by one stage (ISO 50), the level of the Vth is doubled.

(8) Pulse Formation Circuit



① The encoder movement is transformed into the change of light intensity. The change is detected by a photo transistor which outputs sinusodius waves from which square waves are fromed by the circuit.



(The circuit has some hysterisis).

Ⅲ. Digital IC

(A) Terminal Assignments of Digital IC

Pin #	Description
1 . LAD	Analog IC A/D Conversion
2 . $\overline{SP}$	A/D Sampling Signal
3 . $\overline{CHC}$	Flash Light Control Integration Start Signal Output
4 . CMD	Command
5 . DIR	Bus Direction Select
6 ~ 9 .	Data Bus
10. $\overline{CS}$	Chip Select
11. CHS	Flash Light Control Status Input Signal
12. A/D	A/D Conversion Completion Signal
13. INIO	Interrupt Request Output
14. $\overline{HLT}$	Halt Output
15. Vdd	Positive Supply Voltage
17. SO1	Release Switch
18. SO2	Check Switch
19. SO3	Rewind Switch
20. S50	Flash Light Control LED Drive
21. Vcc	Positive Supply Voltage
22. S51	Ave./Spot Select Signal
25. S20	FO Full Aperture F Value
26. S21	F1 Full Aperture F Value
27. S22	F2 Full Aperture F Value
28. S23	F3 Full Aperture F Value
29. S30	CO Aperture Stop-down
30. S31	C1 Aperture Stop-down
31. S32	C2 Aperture Stop-down
32. S33	C3 Aperture Stop-down
33. S40	DXO DX Code Input
34. S41	DX1 DX Code Input
35. S42	DX2 DX Code Input
36. S43	DX3 DX Code Input
37. S44	DX4 DX Code Input
38. S10	Mode Switch
39. S11	ISO Switch
40. S12	Back Cover Switch (OFF when closed)
41. S13	Rewind Shaft Switch (ON when raised)
42~43.	Continuous Automatic Compensation Value
44~47.	Exposure Compensation Value
48. PH	Power Hold
49. Vcc	Positive Supply Voltage
50. Bz	LCD Illuminator LED Drive
51. M2	Second Curtain Control
52. M1	First Curtain Control

53.	GND	Ground
54.	XT	X'tal Oscillator Input
55.	XT	X'tal Oscillator Input
56.	Xin	Flash Light Input Signal

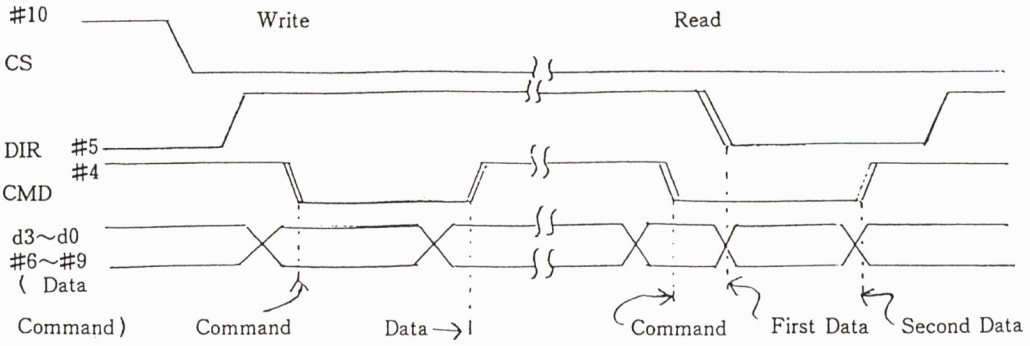
(B) Digital IC and Surrounding Circuits

(1) Digital IC

Data of command transactions with the CPU is accomplished through the data bus D-IC #6～#9 with additional control signals D-IC #4, #5 and #10.

① Timing

* There are 16 commands, No. 0～No. 15, in total.

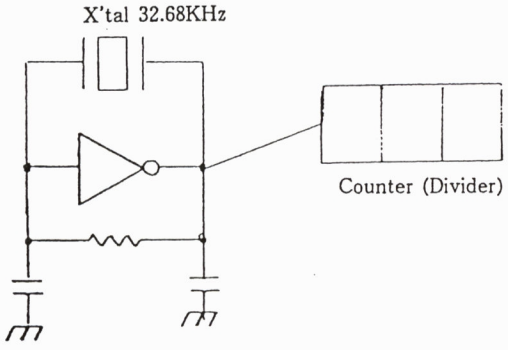


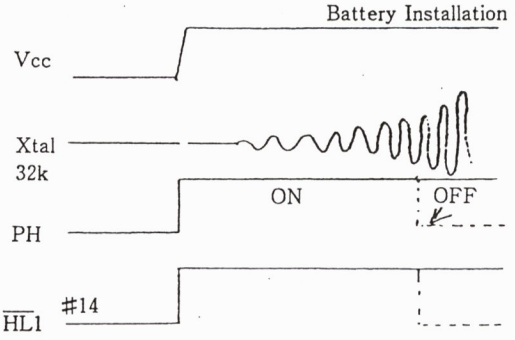
② Data to be written; PH Control, Output Control, Shutter Speed

③ Data to be read; Open Aperture-Value, Aperture Stop Down Information, DX Codes, Switch Status, A/D Conversion Value.

(2) Quartz Oscillator

① The circuit keeps oscillation as long as the main batteries are installed.





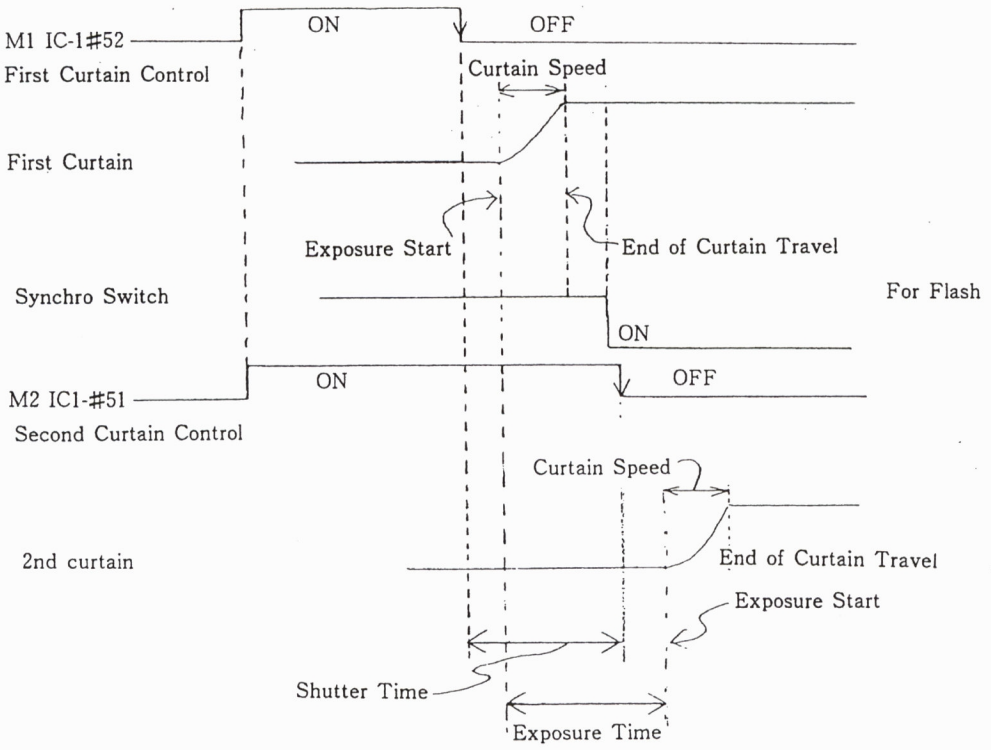
② When the batteries are first installed,the crystal chip starts to oscillate at first with small amplitude.
At the same time the PH signal, D-IC #14, becomes high.

③ After a moment when the oscillation becomes stabilized, the oscillated frequency of 32KHz is used as the system clock.

* When the status of D-IC #14 is high, the CPU starts to function. But if no reason is found to keep the system alive (activation of the check switch, etc.), the system enters into the stand-by mode.

(3) Shutter Control

① Twin Magnet Type driven. Constant current circuit.



② Shutter Time

T=1/2TV (sec.)

Example :

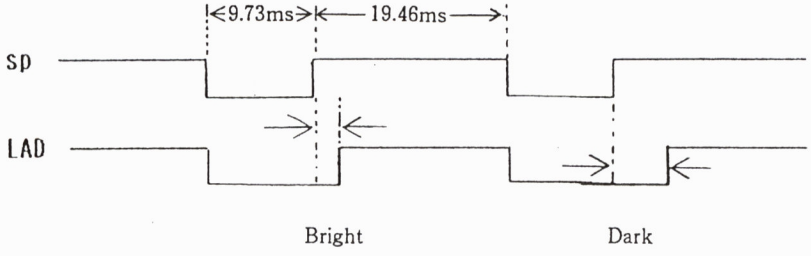
1V	1/1	1(msec)
0	1	1000
⌇	⌇	⌇
7	128	7.8125
⌇	⌇	⌇
12	4096	0.2441

Resolving power : 1/8 EV

* Shutter magnet current needs to be adjusted to a certain predetermined value, for it varies the shutter speed slightly.

(4) D-IC #' 1 and # 2

① The Light metering information obtained from the Analog IC is digitilized and used as brightness information.



The digitalization takes place inside of the Digital IC at a rate of 9.73ms/40 Steps=244μs/1 Step (Step=EV).

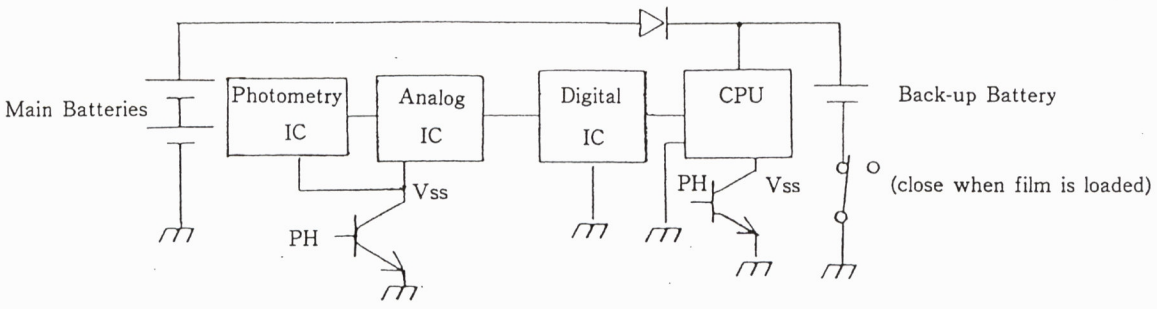
The resolving power is 1/8 EV; BLV 22 is considered to be "OO" (at BLV 21 LAD 244 μ s.).

(5) PH (power Hold) and Memory Back-up

① The function of the main switch is not to turn OFF the power supply, but to prohibit circuit functions, and it acts like a safety lock switch . When the switch is turned OFF, the system enters the stand-by mode. In this mode, however, a negligible amount of current drains (approx. 10 μ A)

② Memory Back-up

When the main batteries are extensively drained or removed for replacement, the back-up battery keeps the memory chip alive to maintain the existing parameters (Film count, operation mode,etc.).In order to extend the life of the back-up battery, a switch is placed in series, which closes the circuit only when the film is installed. No current from the back-up battery is drawn as long as the main batteries are in good condition.



③ PH (Power Hold)

Depending on the status of the PH signal (D-IC #48), the TR-3 and Tr-29 are either turned ON or OFF. When they are turned OFF, the related circuits are disabled, resulting in the substantial reduction of current consumption.

(6) Digital Information Codes

* "O" in the tables below corresponds to "ON" state of the switches and "1 to ."OFF" state.

① Open Aperture Value

F 3	F 2	F 1	F 0	Theta compensation	
				no	yes
0	0	0	1	–	1.2
0	0	1	1	–	1.4
0	0	1	0	2	1.7
0	1	1	0	2.5	2
0	1	1	1	2.8	2.5
0	1	0	1	3.5	2.8
0	1	0	0	4	3.5
1	1	0	0	4.5	4
1	1	0	1	5.6	4.5

② Stop down

C 3	C 2	C 1	C 0	Theta compensation	
				no	yes
0	0	0	1	–	0
0	0	1	1	0	0.5
0	0	1	0	0.5	1
0	1	1	0	1	1.5
0	1	1	1	1.5	2
0	1	0	1	2	2.5
0	1	0	0	2.5	3
1	1	0	0	3	3.5
1	1	0	1	3.5	4
1	1	1	1	4	4.5
1	1	1	0	4.5	5
1	0	1	0	5	5.5
1	0	1	1	5.5	6
1	0	0	1	6	6.5
1	0	0	0	6.5	7
0	0	0	0	7	7.5

③ Exposure Conpensation Code

S 63	S 62	S 61	S 60	E V
0	0	0	1	– 2
0	0	1	1	–1.6
0	0	1	0	–1.3
0	1	1	0	– 1
0	1	1	1	–0.6
0	1	0	1	–0.3
0	1	0	0	0
1	1	0	0	+0.3
1	1	0	1	+0.6
1	1	1	1	1
1	1	1	0	+1.3
1	0	1	0	+1.6
1	0	1	1	+ 2

④ Continuous Exposure (ABC) Compensation Code

S 15	S 14	E V	
		A V	P
1	1	0	0
1	0	0.5	1
0	1	1	1.5

⑤ Operation Mode

D 5	D 4	
1	0	S
1	1	C
0	1	S T

⑥ Light Measuring Mode

R01	R00	
1	1	Lock
0	1	Average
0	0	Spot
1	0	AE-L

(7) Dx Code (code on film cartridge)

DX4	DX3	DX2	DX1	DX0		DX4	DX3	DX2	DX1	DX0	
1	0	1	1	1	25	1	0	0	1	1	400
0	1	1	1	1	32	0	1	0	1	1	500
0	0	1	1	1	40	0	0	0	1	1	640
1	0	1	1	0	50	1	0	0	1	0	800
0	1	1	1	0	64	0	1	0	1	0	1000
0	0	1	1	0	80	0	0	0	1	0	1250
1	0	1	0	1	100	1	0	0	0	1	1600
0	1	1	0	1	125	0	1	0	0	1	2000
0	0	1	0	1	160	0	0	0	0	1	2500
1	0	1	0	0	200	1	0	0	0	0	3200
0	1	1	0	0	250	0	1	0	0	0	4000
0	0	1	0	0	320	0	0	0	0	0	5000

Ⅳ. CPU (Central Processing Unit)

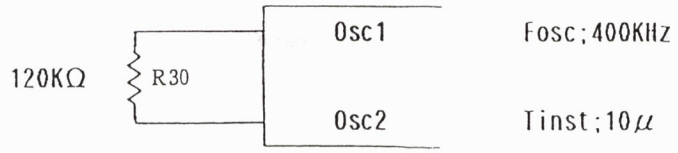
(A) Terminal Assignments for CPU

Pin #		Description
1	LAE1	with Theta compensation
2	2−3	Self Timer, S, C
4	RW2	Rewind Shaft raised
5	RW1	Rewind
6		ISO Data for Data Back
7		Film Detector Switch
8		Timing Switch
9	P-LED	Encoder
10	Y	Mirror up
11	W	Winding
12		FC-Mg Aperture Control
13		Self Timer LED
14∼15		Light metering Mode (Ave., Spot, AEL)
16		Down Switch
17		Up Switch
18	RESET	Reset Input
19		For test (normally pulled-up to Vdd)
20	OSC1	Oscillator (input)
21	OSC2	Oscillator (output)
22	VDD	Positive Supply Voltage
23	HLT	Halt input
24∼25		LCD Drive
26	Vss	LCD Ground
27∼28		LCD Common Ground
31∼62		LCD Segment terminal
63		Ground
64		Interrupt Request
65		Interrupt Request (Encoder)
66	d0	Data Bus
67	d1	Data Bus
68	d2	Data Bus
69	d3	Data Bus
70	B1	Battery Check
71	B2	Battery Check
72	A/D	A/D Conversion Completion
73		Mirror-up Switch
74	Ac/S	Analog Chip Select
75	Dc/s	Digital Chip Select
76	DIR	Output for Mode Selector
77	CMD	Command
78	AJ2	Pulse Adjustment

79	AJ1	Pulse Adjustment
80	LAE2	Without Theta compensation

(B) CPU and Surrounding Circuits

(1) Oscillator (RF Oscillation)

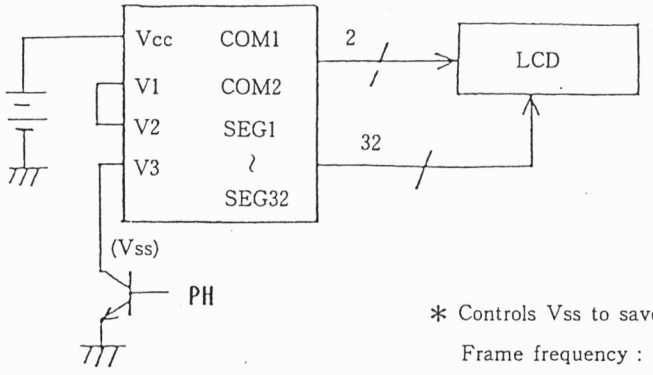


(2) CPU

① CMOS, 4-bit microcomputer with built-in 4096 word LCD driver

② LCD Drive

(1/2 Duty 1/2 Bias)



(3) Terminal Functions

① # 1 and # 80 (LAE 2 and LAE 1)

Program lens identification signal input

80 (LAE 2) : without Theta compenstaion when low

1 (LAE 1) : with Theta compenstaion when low

② # 4 and 5 (RW 2 and RW 1)

The Rewind Shaft rises or Rewind Shaft down and rewinds by motor forward rotation or reverse rotation.

4 (RW 2) : The rewind shaft rises

5 (RW 1) : The rewind shaft downs and rewinds

③ # 6 (DB, ISO)

ISO setting output for data back

"L" when ISO 400 or more

"H" when ISO 320 or less

④ # 8 (Timing Switch)

Film Winding Completion Signal

Winding is complete when the Timing Switch turns OFF.

⑤ # 73 (Mirror-up Switch)

Mirror-up completion Signal

Mirror is rose Completed when the Mirror-up Switch turns ON

⑥ # 10 and # 11 (Y, W)

Mirror-up or film winding is performed depending on direction of the motor rotation.

Y : Mirror-up Signal

W : Film Winding Signal

⑦ # 16 and # 17 (Down, Up)

Operation mode, shutter time and ISO setting can be altered.

⑧ # 20 and # 21 (OSC2, OSC1)

RF Oscillator terminal for systems clock

⑨ # 7 (Film Detection Switch)

Checks existence or absence of the film. When the film is inside, the status of this terminal becomes high. The switch is used both as battery back-up when film is installed.

⑩ # 9 and # 12 (P-LED, FC-Mg)

Functional in programmed control mode

P-LED signal is for the encoder LED drive.

FC-Mg signal is for the aperture control magnet.

⑪ # 71 and #70 (B2, B1)

Battery status signals

B2	B1	Display	Camera Function	Battery Status
H	H	Normal	Normal	Normal
H	L	blinks at 2KHz	Normal	Low Battery
L	L	blinks at 4KHz	Disabled	No Battery Power

⑫ # 78 and # 79 (AJ2, AJ1)

Aperture Mechanism delay Compensation

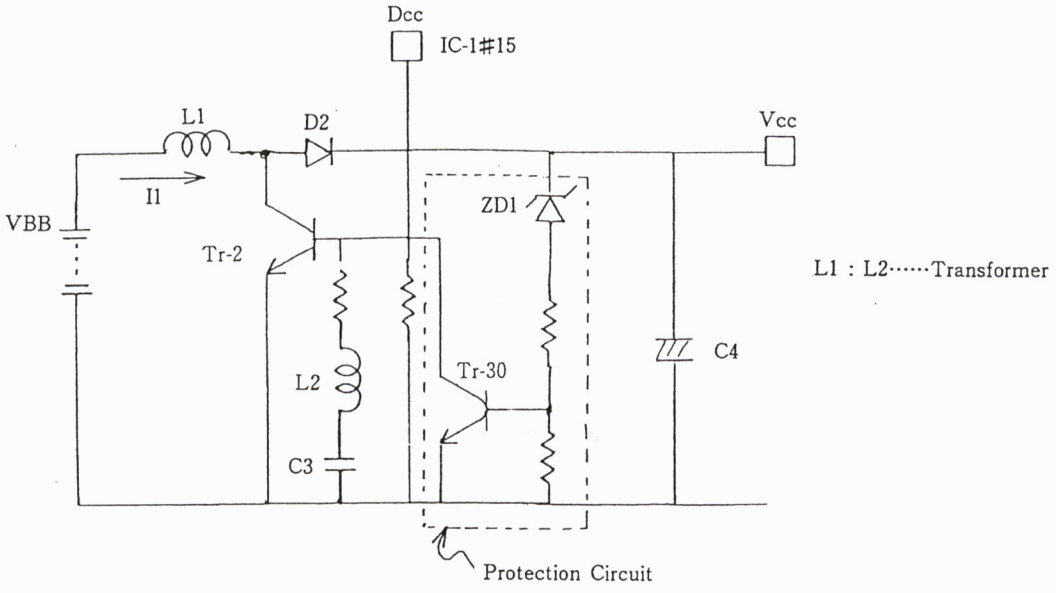
AJ2	AJ1	Delay Pulse
H	H	4
H	L	3
L	H	2
L	L	1

* "L" : Pin soldered to GND

"H" : Pin left open

Ⅴ. Other Circuits

1) Voltage Booster



① When both Vbb and Vcc are low, Dcc is turned ON (high) and Tr-2 becomes active. (Booster functional)

② When current I1 draws through L1, voltaga is generated across L2, raising the base voltage of Tr-2. This results in the increased current of I1.

③ When the Tr-2 becomes saturated, the current I1 becomes constant, turning the base voltage of the Tr-2 low. This brings the Tr-2 into its dynamic range again, and the above sequence repeats itself.

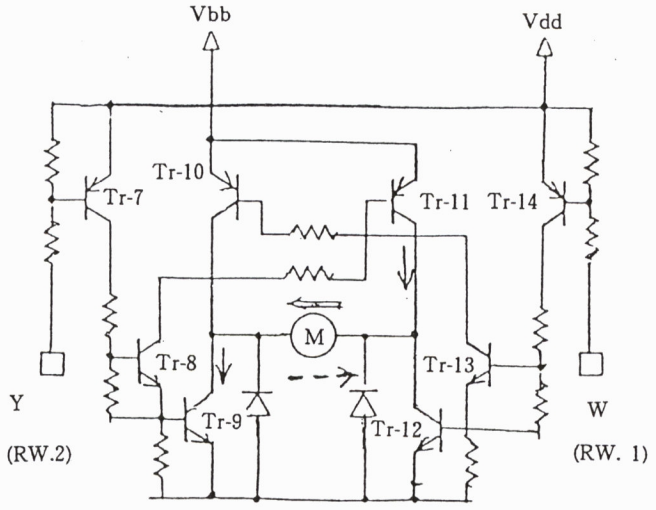
④ Thus, the generated current is rectified by the diode and the capacitor is charged which, in turn, provides constant voltage to Vcc, even in the low battery condition.

* The booster starts to function when battery voltage falls to about 4.8V and continues to function to about 2V.

2) Protection Circuit

If the boosted voltage becomes abnormally high for some unexpected reasons, Tr-30 will be turned ON at around 8V to disable Tr-2

3) Motor Drive Circuit



M : Motor

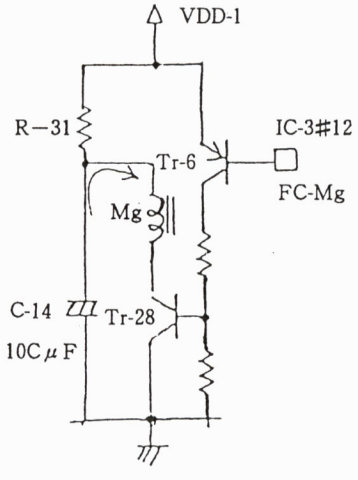
① Two motors are used in the camera body. One motor auto-loads and advances the film, resets the mirror and aperture, and sets the shutter after each exposure, and mirror rises. The other moter is used exclusively to rewind the film. The motors are driven by two identical circuits.

② When Y signal (Mirror-up) is turned to low, Tr-7 turns ON, followed by the activation of Tr-8. Power transiators Tr-9 and Tr-11 are also turned ON. The current runs through the motor (M) from right to left (Forward Rotation)

③ When W signal (Winding) is turned to low, likewise the power transistors Tr-10 and Tr-12 will be turned ON. The current runs through motor from the left to the right. The motor turns in the opposite ditection (Reverse Rotation).

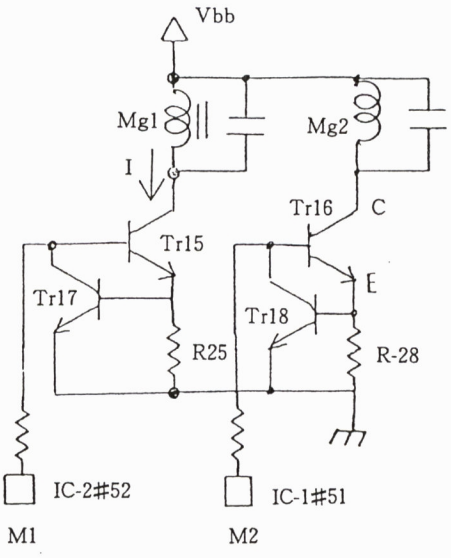
④ Film rewinding takes place in the same manner.
When RW2 is low, the Rewind Shaft is rose. When RW1 is low, the Rewind Shaft is down and the film is rewound.

4) FC-Mg Drive Circuit



When the FC-Mg signal is turned to low, Tr-6 and Tr-28 turn ON, allowing the capacitor C-14 to discharge through the magnet. As a result, the armature is released. The charge current to the capacitor runs through R-31. (This circuit minimizes the effects of low battery on the magnet function)
Magnet impedance is about 16 ohms.

5) Shutter Mg Drive Circuit



The first and the second curtains of the shutter are independently controlled by the two magnets.

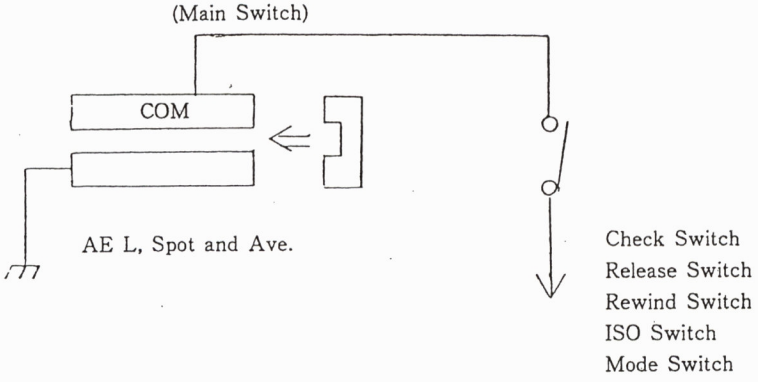
A constant current circuitry is employed to minimize influence of battery condition.

When M1 signal (D-IC #52) is turned to high, Tr-15 turns ON, which draws current I. Consequently, voltage appears across R-25, affecting Vce of Tr-17,which, in turn, changes Vbe of TR-15 to maintain the current constant.

The M1 signal controls the first curtain. An identical circuitry is used for the M2 signal, which controls the second curtain.

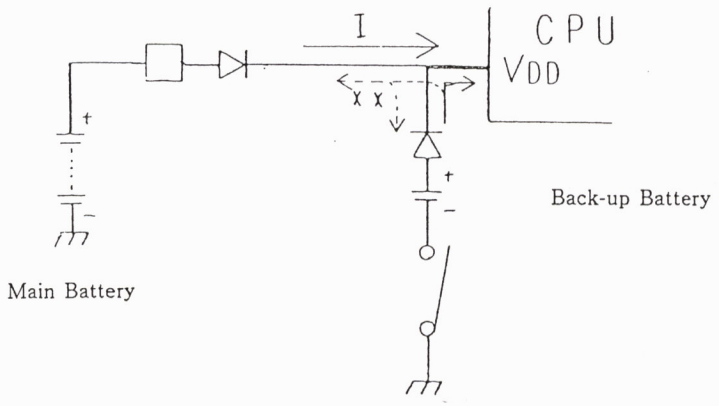
6) Switches

Some switches (AE L, Spot and Ave.) function only when the main switch is turned ON. Others are independent from the main switch.

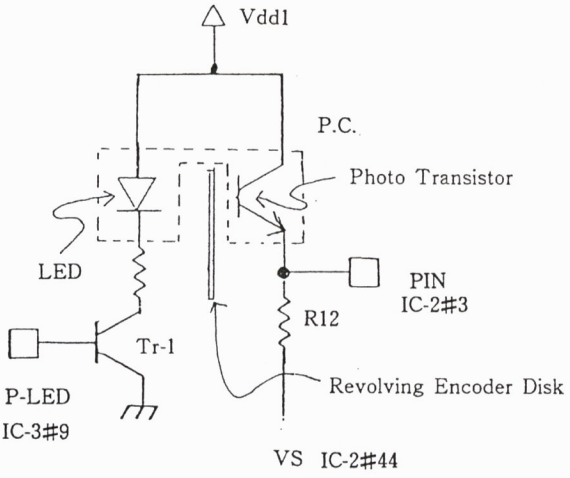


7) battery Back-up

Normally voltage of the main batteries is higher than that of the back-up battery, and the current is provided from the main battery. The diodes prevent current in undesirable directions.



8) Encoder and Aperture Control



(1) P.C. : Photo Coupler

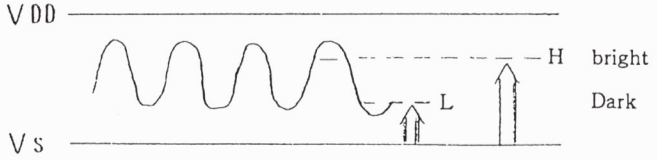
A pair of LED and photo transistor change of light into electrical signal. The LED radiates non-visible infrared rays.

When P-LED signal turns to high, the LED transmits the rays, which turn ON the photo transistor. As a result, the voltage at the Pin (A-IC, #3) goes high.

When the revolving encoder blocks the light path, the current through the photo transistor decreases, and at the same time,the pin voltage (A-IC, #3) drops.

(2) Pulse Formation

When the encoder disk rotates, encoder slits turn ON and OFF the photo transistor intermittently, and corresponding pulses are generated.



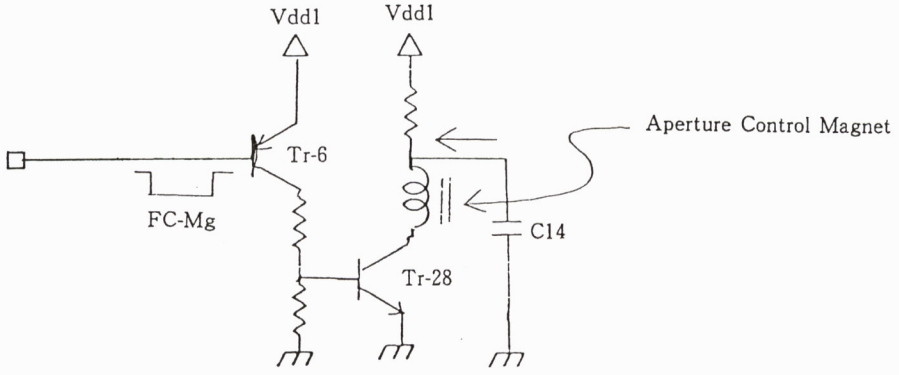
The output waveforms are digitized by the IC using two thresholds, both of which are measured from the Vs level (standard voltage)

Specifications :

L=Approx. 50mV H=Approx. 400mV

(Amplitude of the waveform decreases as the disk spins faster.)

(3) Aperture Control



① First, the brightness of the object is measured, and the shutter speed and Aperture value are computed.

② when the shutter release button is depressed, Y-signal is generated and the following take place :

Mirror starts to rise up

Aperture Lever begins its travel

(Aperture ring in the body)

Encoder rotates and pulses appear at Pin

③ The IC counts the pulses and releases the FC-Mg signal when the count reaches a certain pre-determined value. The Aperture Ring is then held at its current position to provide correct aperture size.

(4) Aperture Pulses

Eight pulses are generated per Aperture. The preliminary rotation of the ring (until the aperture blades are actually actuated) is equivalent to six pulses.

E.g. F1.4 lens to step down to F5.6 (4 stops)

Number of Aperture Pulses = $6 + (8 \times 4) = 38$

FC-Mg is released after 36 pulses.

However, due to the presence of mechanical delay (magnet and lever response, etc.), the number of the pulses may need to be compensated. The compensation can be done electronically. Depending upon the mechanical delay, the number of pulses are reduced according to the code given to Aj2 and Aj1 (CPU # 78 and # 79).

E.g.-4 pulses to be compensated.

Status of Aj2 and Aj1 is open (high)

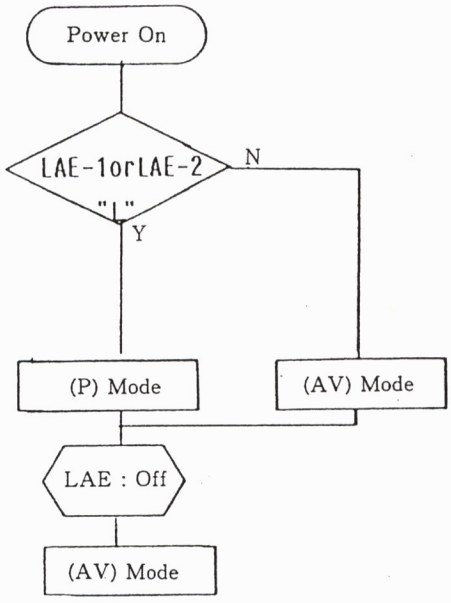
(refer to IV-B-12)

Number of Aperture pulses is determined to be :

$6 + (8 \times 4) - 4 = 38 - 4 = 34$

VI. Circuit Flowcharts

1) Power on Reset



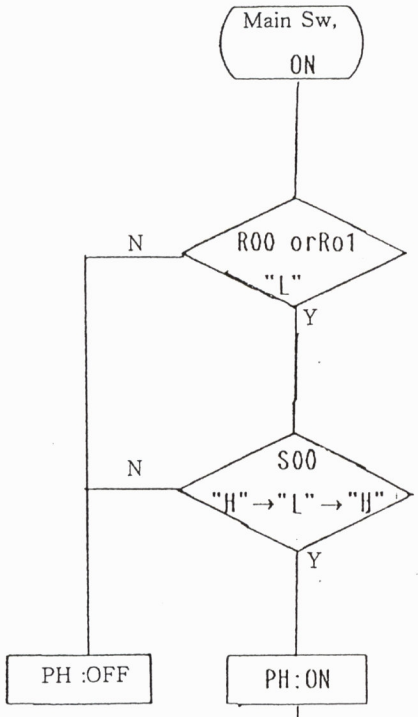
: without back-up power source

LAE-1 or LAE-2 to be low when set the MM type lens.

: Lens removed

2) PH (Power Hold) : ON

(1) Main Switch OFF → ON

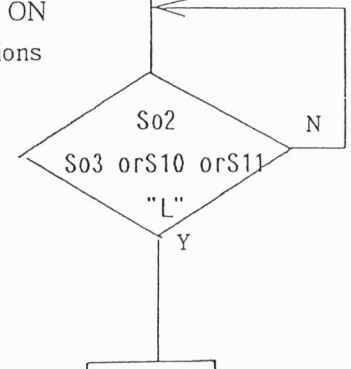


To turn PH ON, the following should take place at the Main switch slide pattern :

R01 (Ave., Spot, AE-L Select) : "L"
S02 (Check Switch ON) : "H"→"L"→"H"
R01 :"L"→Averaged measuring
R01 and Roo :"L"→Spot metering
R00 :"L"→AE-L

PH : ON Amplifies active, LCD turned ON.
PH : OFF PH disabled

(2) Main Switch ON
Other conditions



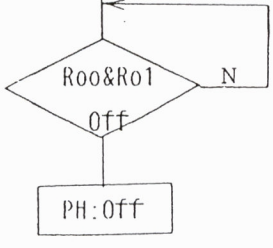
S02 : Check SW
S03 : Rewind SW
S10 : Mode SW
S11 : ISO SW

To turn PH ON The"L"status of any one of the following switch or pattern condition turns PH ON

3) PH : OFF

(1) Immediately

turn PH OFF Refer to the section 3) -(2) on the following page



At the main switch slide pattern,R00 and R01 cut OFF from the GND level and PH turns OFF

(2) Requirements to turn PH OFF after 16 seconds

① Shift of status from ON to OFF at any one of the switches ; S02 (Check SW), S10 (Mode SW). S11 (ISO SW).

② Change of time setting by R02 (DOWN) or R03 (UP) in M(Manual) or TV mode

③ Change of status of C0-C3 (Aperture Stop-duwn data)

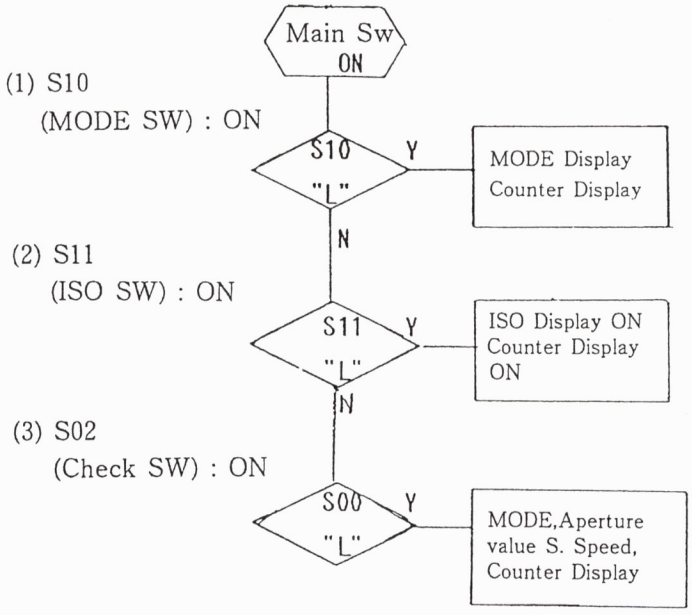
④ Completion of W (winding) signal

⑤ Change of status at R00 and R01 (AE-L : ON→OFF)

※ The time needs not to be 16 seconds in this case (same as AVE→SPOT changeovor).

⑥ Incase of any trouble

4) LCD Display



Current mode setting to be displayed. Counter indicates the exposed frames (up to 39)

Current ISO setting to be displayed

Displays condition requirement when Check SW is turned ON

(4) R00 and R01 (AVE., SPOT, AE-L Changeover) : F-LCD Drive (Viewfinder Display)

R01"L" : Ave. ◎ Turned OFF

R00 and R01 is "L" : SPOT ◎ Turned ON

R00"L" : AE-L ◎ blinks (2 HZ)

(5) F-LCD +/− Display

① When exposure compensation is made by the switches S14 and S15, either"+"or-"−"sign is turned ON

② Under-or over exposure in M-MODE turns the"+"sign blinks or"−"sign at 2 Hz.

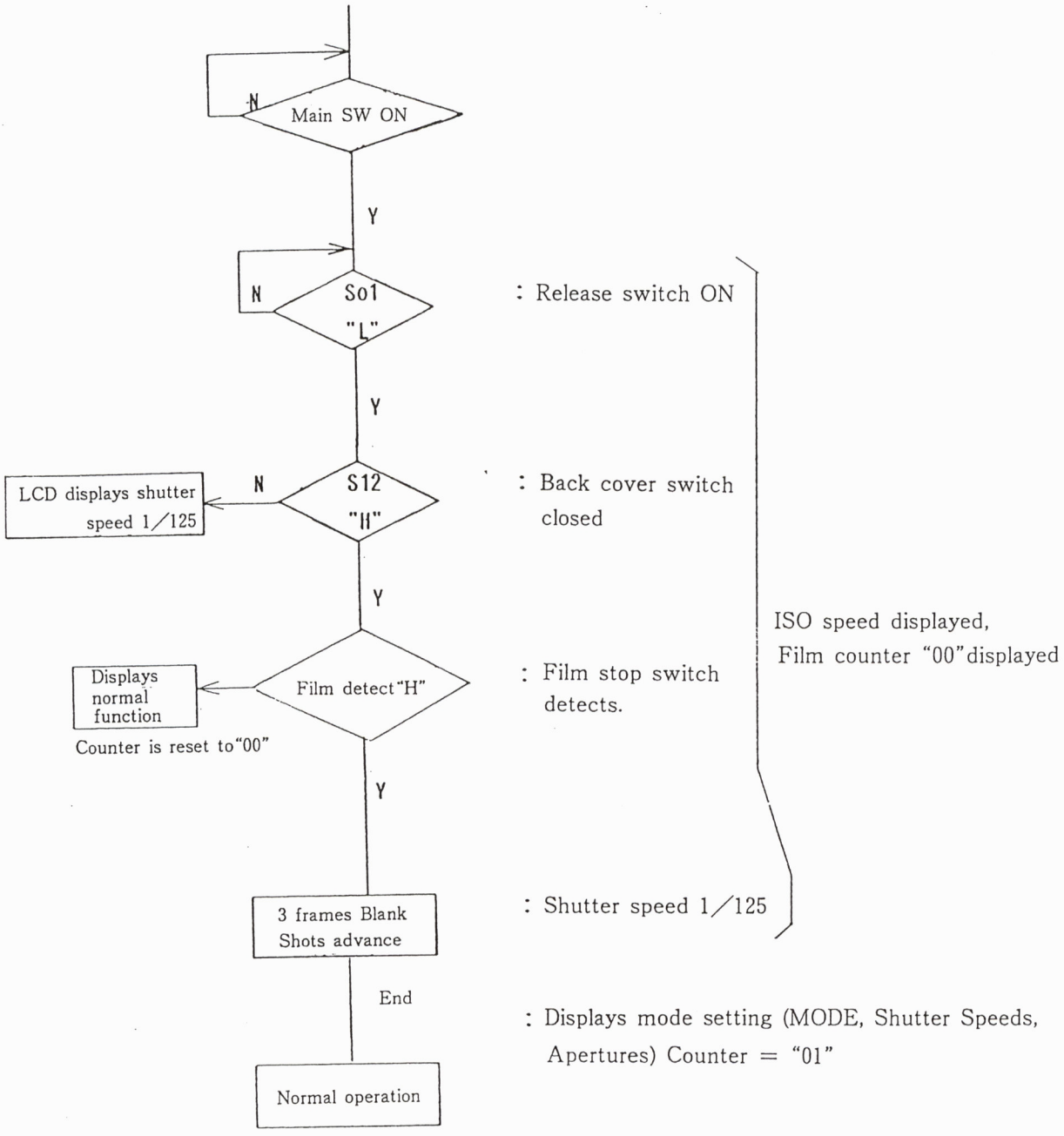
(6) During shutter actuation (curtains open) and winding (W signal) :

① MODE, Shutter Speed, Counter display are turned ON.

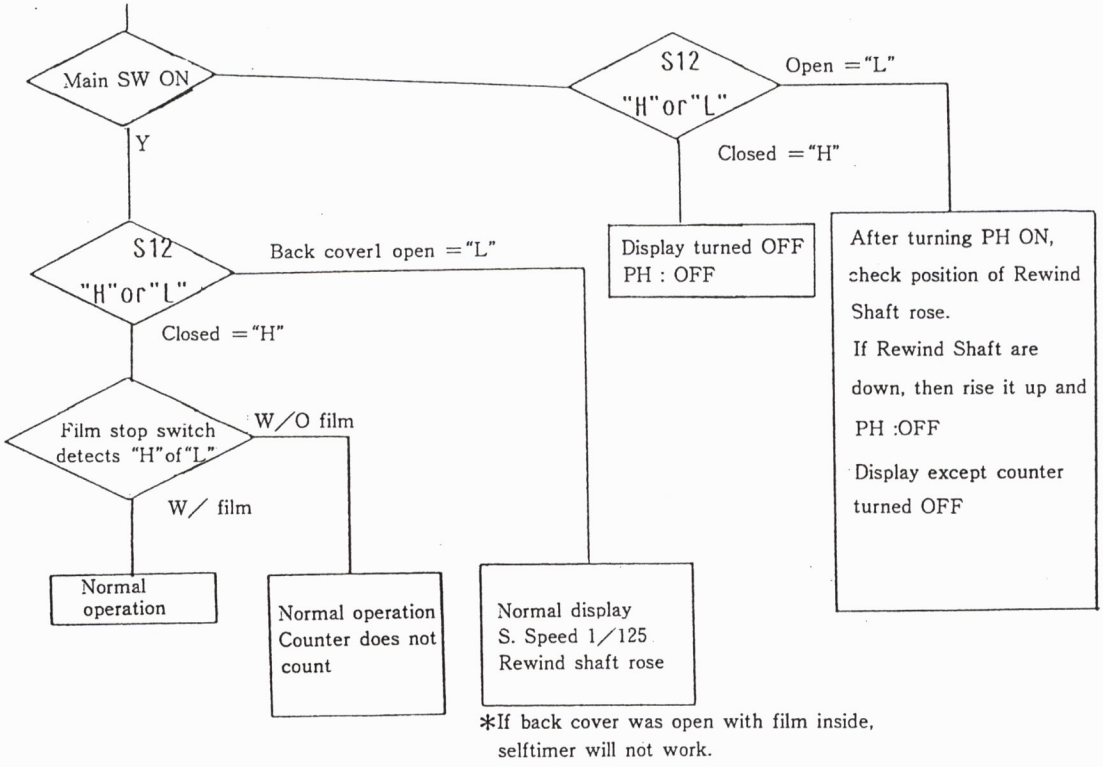
(7) During rewinding

① ◎◁◁ (rewind mark) is turned ON and counter blinks.

5) Blank Shots Film Advancement (3 frames)



6) Back Cover Switch

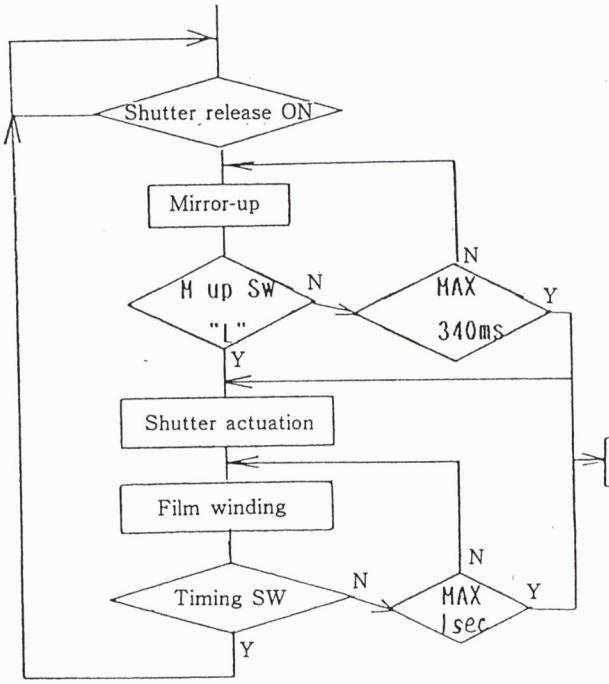


*If back cover was open with film inside, selftimer will not work.

7) Error Indication

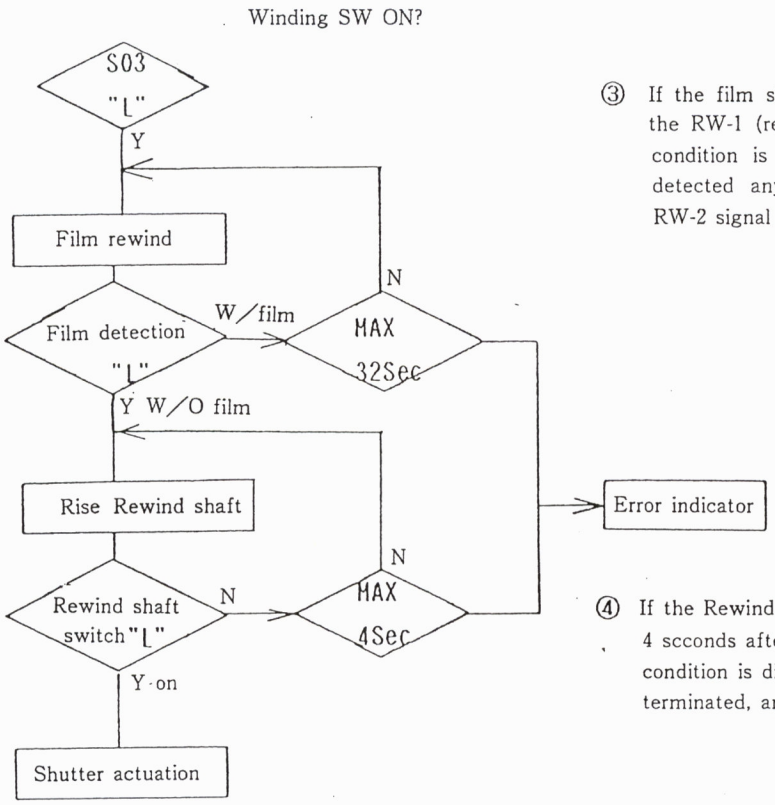
LCD blinks at 2Hz (Previous status display)

*PH : OFF after 16 seconds or main SW OFF. Then display off.



① If the Mirror-up switch should not turn ON ("L") within 340mSec. the Y (Mirror-up) signal is released, to activate the shutter abnormal condition are stay.

② If the timing switch should not turn OFF ("H") within one second the W (winding) signal is released, abnormal condition are stay.

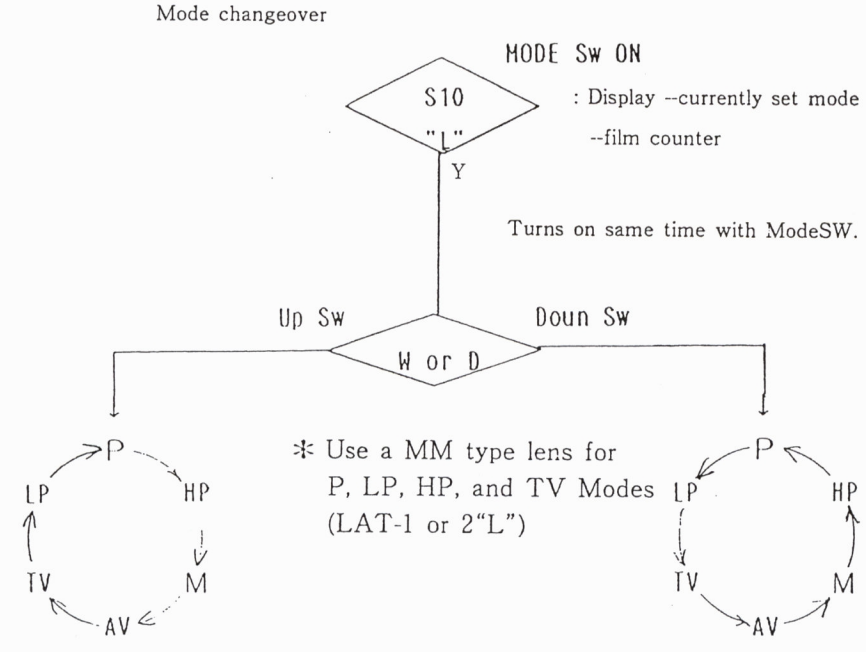


③ If the film should be detected beyond 32 secinds after the RW-1 (rewind) signal is first provided, an error condition is displayed. Otherwise, when the film is not detected any more, the RW-1 signal is terminated and RW-2 signal is provided.

④ If the Rewind shaft switch should not be turned on beyond 4 scconds after the RW-2 signal is provided, an error condition is displayed. Otherwise, the RW-2 signal is terminated, and the shutter is tripped once.

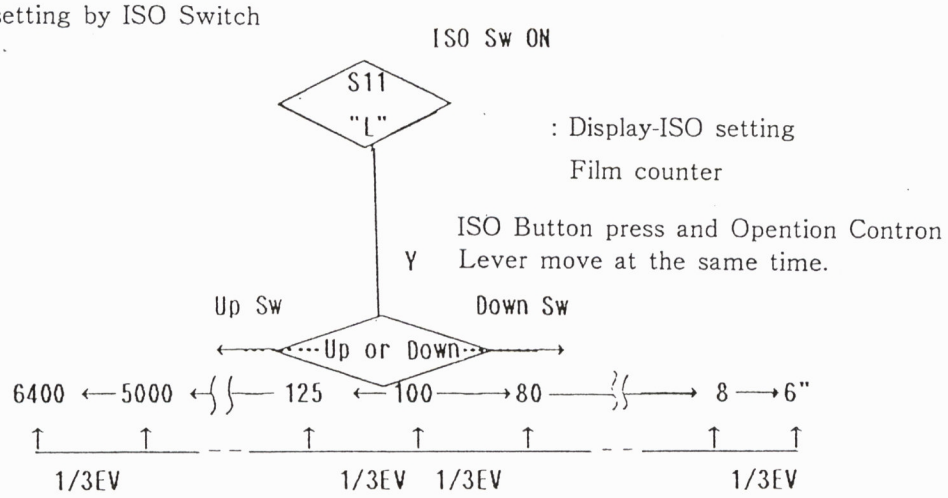
✻ The RW-2 signa lis also generated for 4 seconds when the back cover is opened. During this period, the condition of the rewind shaft is monitored. An error condition is displayed if the condition (R shaft stay down) was met in the 4 seconds.

8) Exposure mode



9) ISO

(1) ISO setting by ISO Switch



(2) ISO setting by DX Code Sensing

① When the back cover is closed (back cover switch status"L"→"H"), the DX code is read at the next PH : ON.

② If the code was not read (no film loaded or film with non DX coded), the previous ISO remains unchanged.

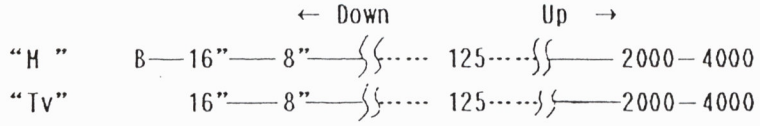
③ At the power-on-reset (when the power is first turned on), the ISO setting will be at 100, provided there is no back-up battery holding the memory alive and non DX code is sensed.

(3) ISO Code Output

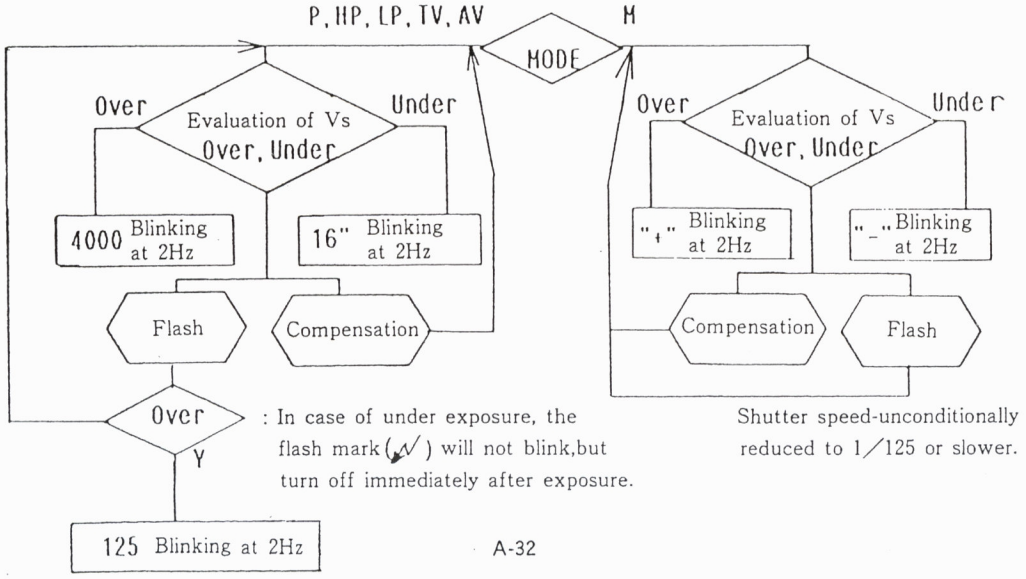
The ISO code is provided to the Analog IC via data bus (do-do). The information is used to determine Vs-Vth voltage which is used for Flash light control.

10) Determination of Shutter Time

The shutter time can be selected by the operation lever in M or TV modes.



11) Over-and Under Exposure warning



: In case of under exposure, the flash mark (⚡) will not blink,but turn off immediately after exposure.

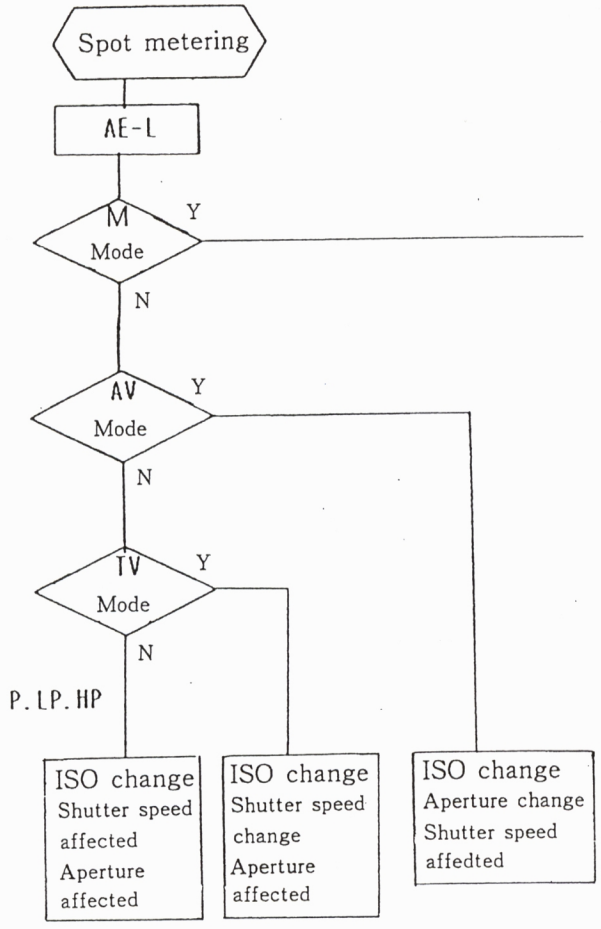
Shutter speed-unconditionally reduced to 1/125 or slower.

12) Light Metering Mode Sctting

CPU#14	CPU#15	A-IC#41	
"H"	"L"	"H"	1 Display (F-LCD)
"L"	"L"	"L"	No display
			◎ symbol turn ON

13) AE-L (Exposure Values memory system)

*Spot metering AE-L with F-LCD display and ◎ symbol blinking at 2 Hz



*M mode AE-L

ISO, shutter speed, Aperture setting, etc. can be changed without producing practical effects. (+, −display)

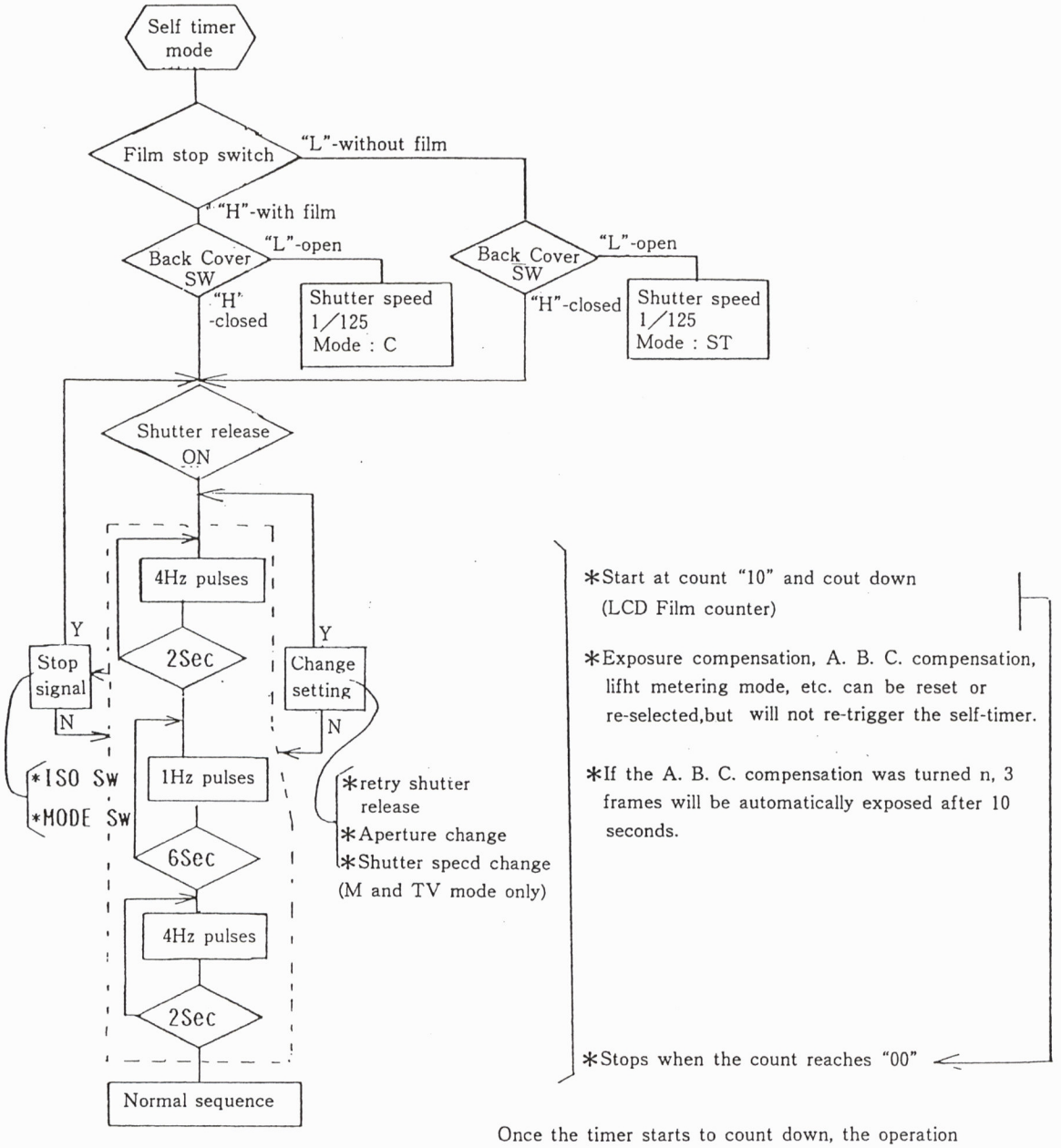
*At the AE-L, the compensation factor (S60-S63) and the automatic continuous compensation factor (S14 and S15) can be changed.

14) Self Timer

The self timer mode is entered when the condition D5"L"and D4"H" (ST position at S-C-ST select switch) is met.

When the shutter rclease button is pressed (SO1"L"), the following will take place:

0 to 2 sec. D15 outputs 4Hz pulses (LED blinking)
2 to 8 sec. 〃 1Hz 〃 〃
8 to 10 sec. 〃 4Hz 〃 〃

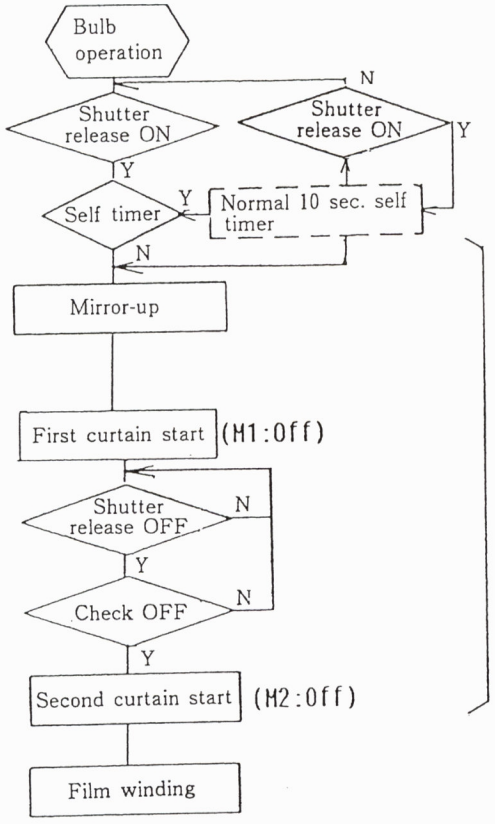


Once the timer starts to count down, the operation will not be interrupted by opening of the back cover (ON"L").

When the cover is closed again, the timer stops (OFF : "H").

15) Bulb

The bulb setting is considered to be the slowest shutter speed setting in M mode and is selected by operation of the Down switch.



*Self timer and bulb operation may not be combined. However,bulb functions as long as the shutter release button is pressed.

*Counter begins at"00"and count up every second. When the count reaches 59. it is reset to"00"and the sequence is repeated.

┌→00→01→02·····57→58→59┐

*Once the bulb operation is initiated, change of Aperture will not affect the display read out.
No other information is accepted except turning off the main switch.

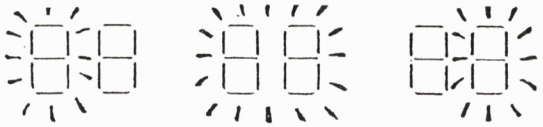
*Bulb operation continues even when the shutter release switch is released as logn as the check switch is turned on.

16) Exposure Compensation

1 Up to ±2EV at 1/3EV step : Depends on status of S60-S63 (D-1C, #44-47)
2 Turn ON of either -+ or — symbol in F-LCD
3 Not works in M mode (though status is displayed)

17) 3 Frame Automatic Continuous (ABC) Exposure Compensatipn

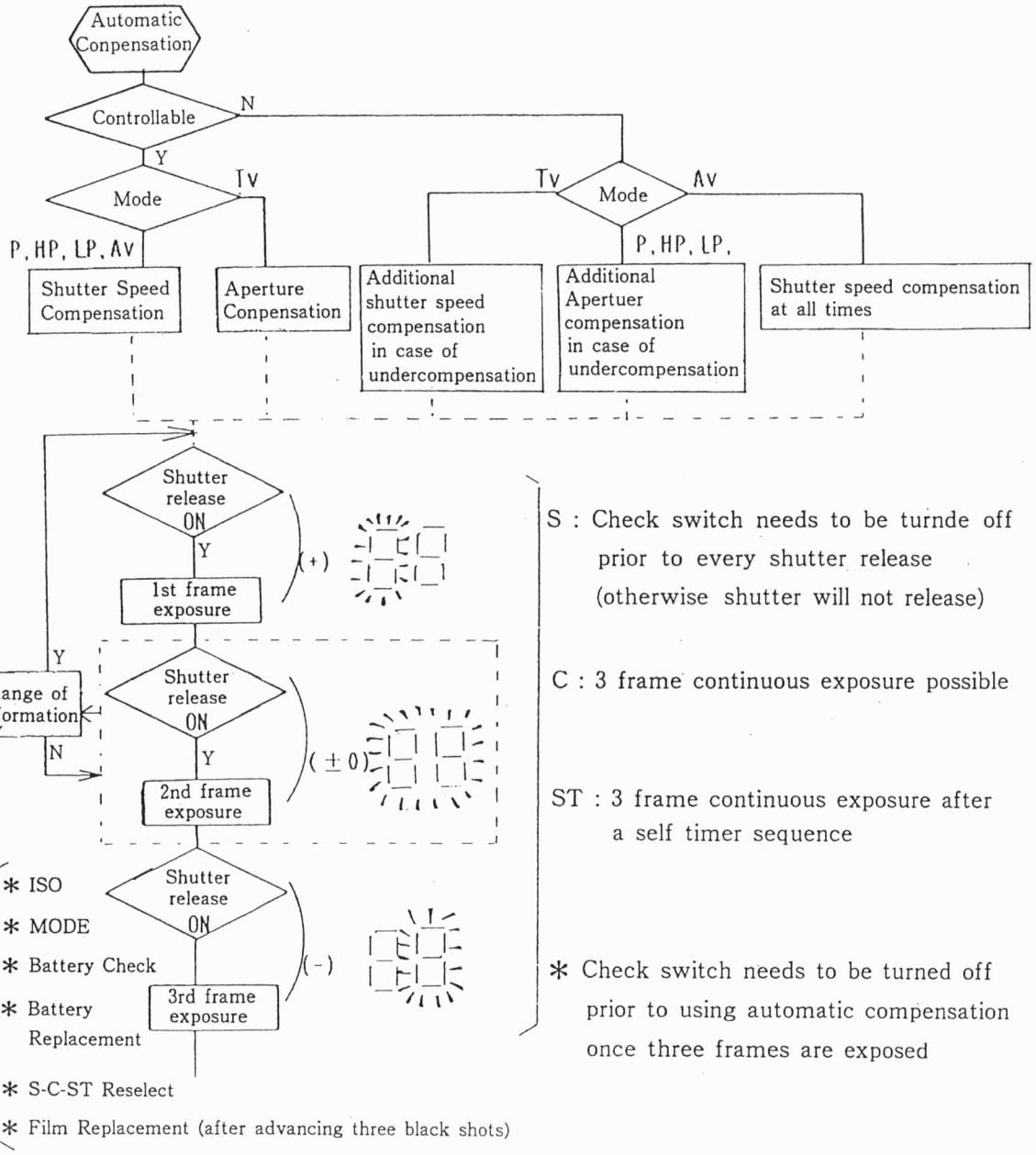
* 3 Frame Display 1st frame → 2nd frame → 3rd frame



* Compensating Value

Exposure Mode	S14 : "L"	S15 : "L"
AV	±0.5 VE	±1 EV
P, HP, LP, TV	±1 EV	±1.5 EV

* Guide line of mode of compensation
P, HP, LP, AV···Shutter Speed will change
TV···Aperture will change



S : Check switch needs to be turnde off prior to every shutter release (otherwise shutter will not release)

C : 3 frame continuous exposure possible

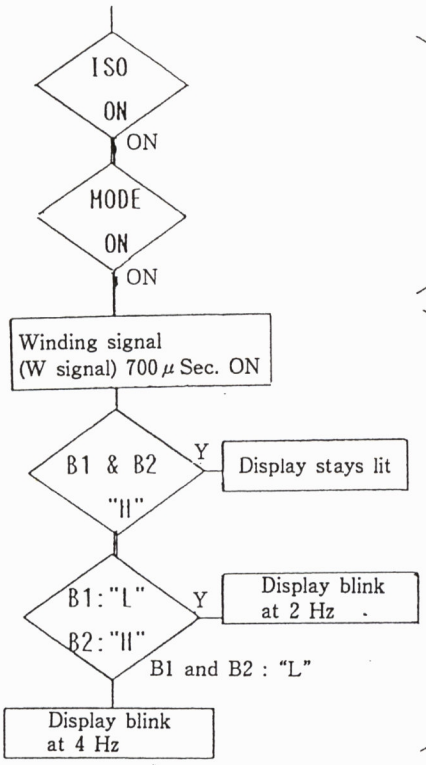
ST : 3 frame continuous exposure after a self timer sequence

* Check switch needs to be turned off prior to using automatic compensation once three frames are exposed

18) Battery Check

(1) Manual Battery Check (with ISO and MODE switches)

When both ISO and MODE switches are turned ON (S11 : "L" and S10 : "L"), the winding signal (W signal) is turned ON for 700 μ Sec. at 1 sec. intervals. Associated change of the supply voltage is monitored (Analog IC, B1 and B2 signals), and the condition is displayed on the LCD.



* Once the two switches (ISO and MODE) are turned ON, battery check function continues even when either one of the switches is turned OFF. when both switches are turned OFF, the battery check sequence will be interrupted
* Repeats every second during battery check mode.

B2	B1	Display
"H"	"H"	Stays lit
"H"	"L"	Blink at 2 Hz
"L"	"L"	Blink at 4 Hz

(applicable to both automatic and manual battery check)

(2) Automatic Battery Check (Automatic check during other sequences)

① Monitor voltage about 120 μ Sec. after Mirror-up signal is turned ON

② Monitor voltage about 120 μ Sec. after winding signal is turned ON at the end of an exposure

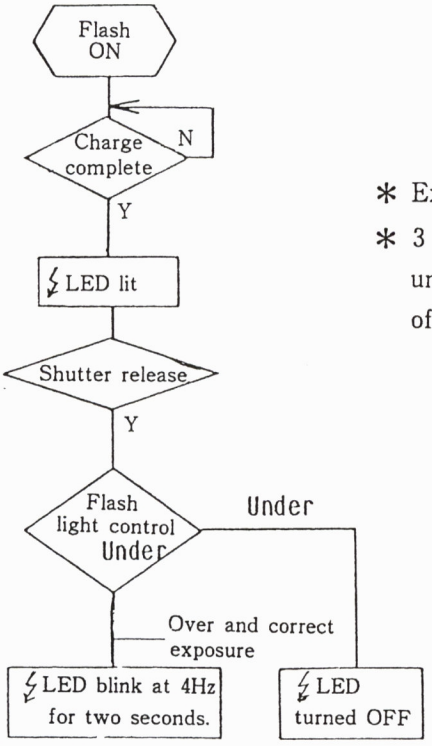
③ Monitor voltage about 120 μ Sec. after rewind signal (RW 1) is turned ON when the rewind switch is turned ON

Depending on the monitored battery condition (A-IC, B1 and B2), the results are displayed on the LCD and a decision is made whether to continue or to terminate the current sequence.

19) F-LCD Back Ground Illumination

① F-LCD is illuminated (Bz ; D-IC, #50) when the check switch is turned ON (SO2 ; D-IC, #18).

20) Flash Light Control



* Exposure compensation is possible
* 3 frame ABC exposure compensation functions until flash charge is conplete Upon completion of charge, normal flash exposure sequence overrides.

21) S-C Function (combination of D4 and D5)

(1) C (continuons)

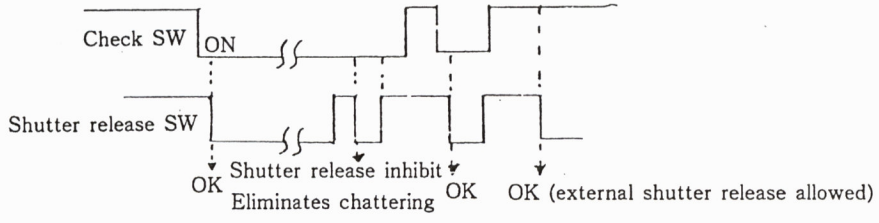
* Continuous exposure mode···Both D4 and D5 are "H".

(2) S (single)

* Single exposure mode···D4 is "L",D5 is "H".
* Minimum shutter release time···15mSec. approx.
* Shutter release prohibit

-Continuous Shutter release is prohibited.

-Check switch needs to be turned off prior to every exposure.



22) Signals to Daya Back

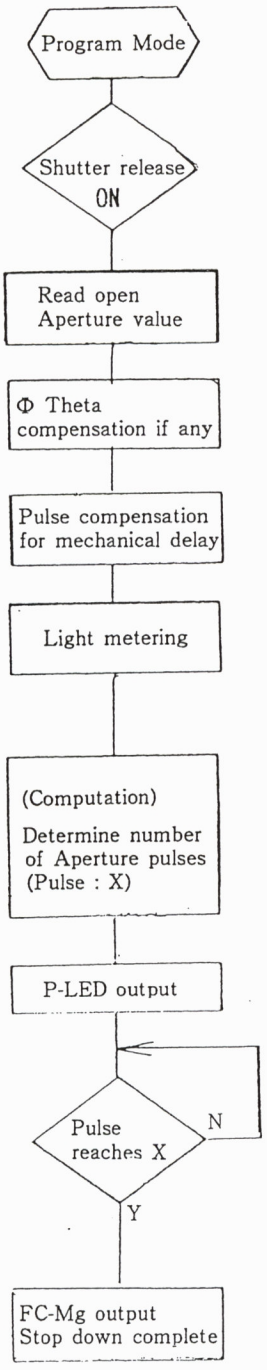
(1) D. B. -PRINT (data back print signal)

The signal turns on simultaneously with Mirror-up (Y) signal (when the shutter release switch is closed.)

(2) D. B. : ISO (data back ISO change signal)

The "L" state is output at ISO 400 or higher.

23) Program Sequence (P, HP, LP and TV)



: (P, HP, LP and TV) Either LAE1 or LAE2 turns on with MM Type lenses.

: F0-F3 (Full-aperture value)
Reads in the Full-aperyure value of lens used.

: LAE1 and LAE2···LAE1 :ON, "L" when lens with theta compensation used.
LAE1 : ON, "L" when lens without theta compensation used.

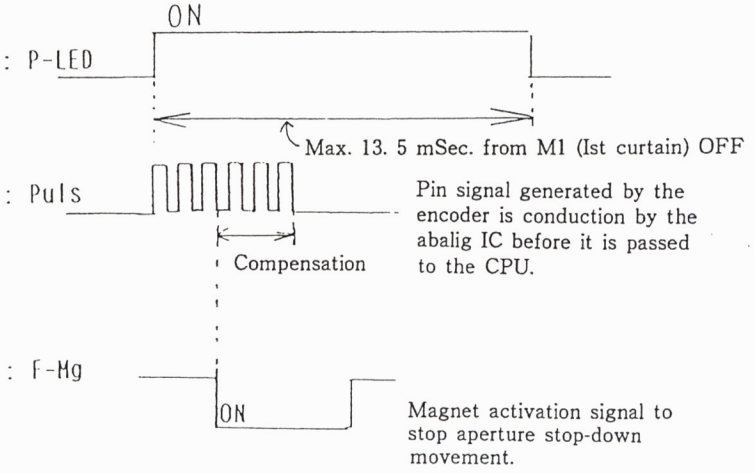
: Aj1 and Aj2 (Adjustment of stop down amount)

Aj2	Aj1	Adj. Pulses	Delay Pulse
H	H	2	4
H	L	3	3
L	H	4	2
L	L	5	1

: X (number of pulses) = 8 x No. of F-Stops + Adj. pulses.

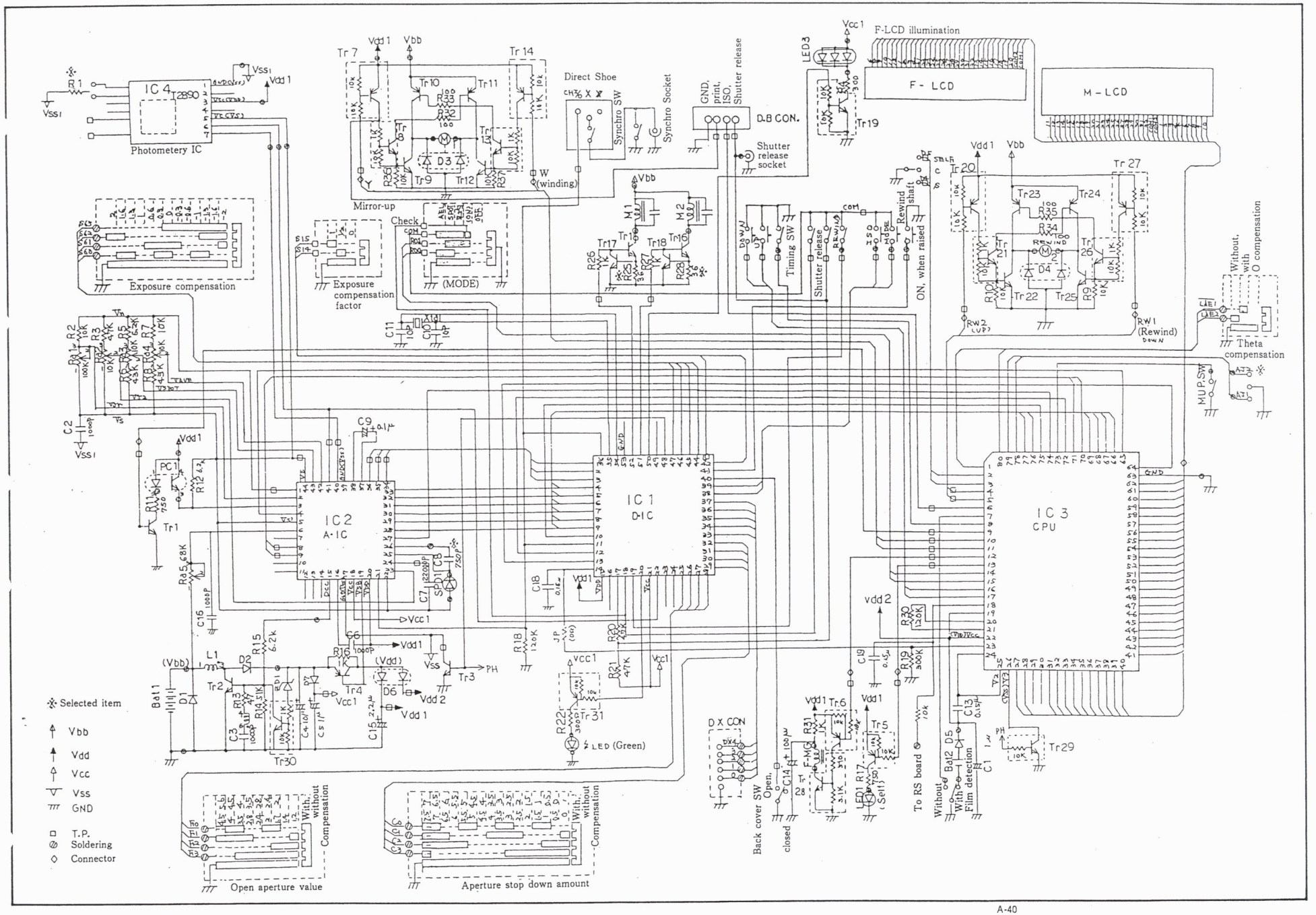
Number of pulses per F-Stop

Adjusted individually during production



Pin signal generated by the encoder is conduction by the abalig IC before it is passed to the CPU.

Magnet activation signal to stop aperture stop-down movement.


IC 4
Photometery IC
Mirror-up
Check
(MODE)
Exposure compensation
Exposure compensation factor
Direct Shoe
Synchro SW
Synchro Socket
D.B CON.
GND, print, ISO, Shutter release
Shutter release socket
W (winding)
F-LCD illumination
F - LCD
M - LCD
Timing SW
Shutter release
Rewind shaft
ON, when raised
RW2 (UP)
RW1 (Rewind)
Theta compensation
MUP SW
IC 1
D-IC
IC 2
A-IC
IC 3
CPU
Tr1
Tr2
Tr3
Tr4
Tr5
Tr6
Tr29
Tr30
Tr31
LED (Green)
LED1
To RS board
Film detection
Back cover SW
Open, closed
Open aperture value
Aperture stop down amount
With compensation
Without compensation
Selected item
Vbb
Vdd
Vcc
Vss
GND
T.P.
Soldering
Connector

Internal Mechanism Layout

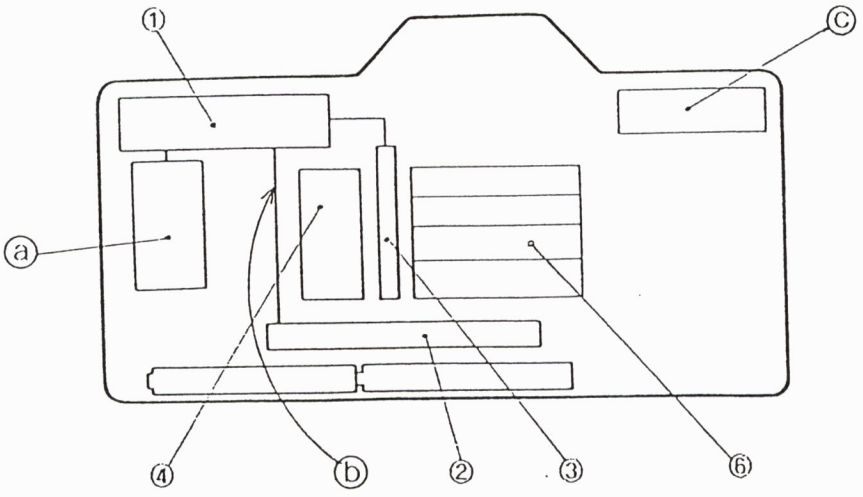
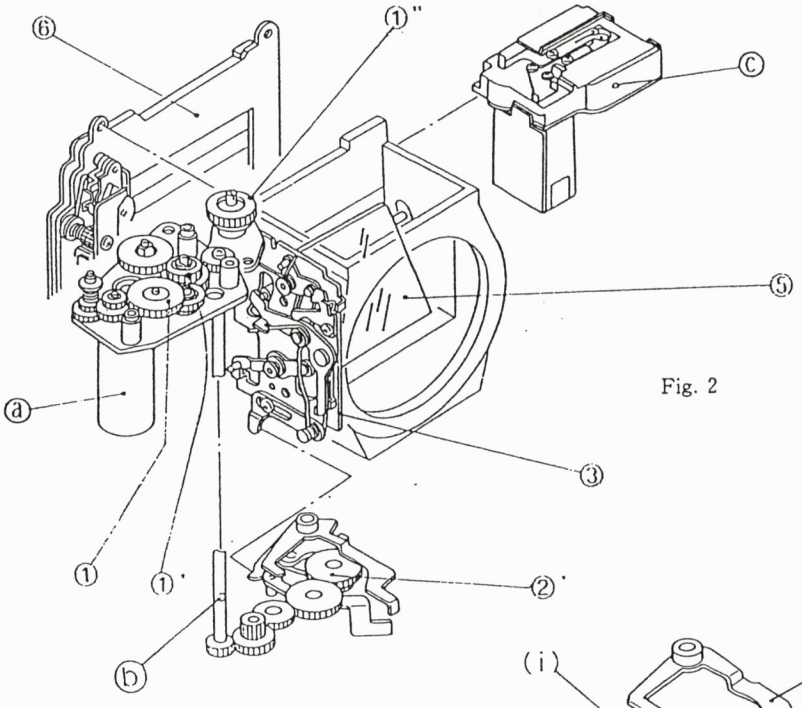
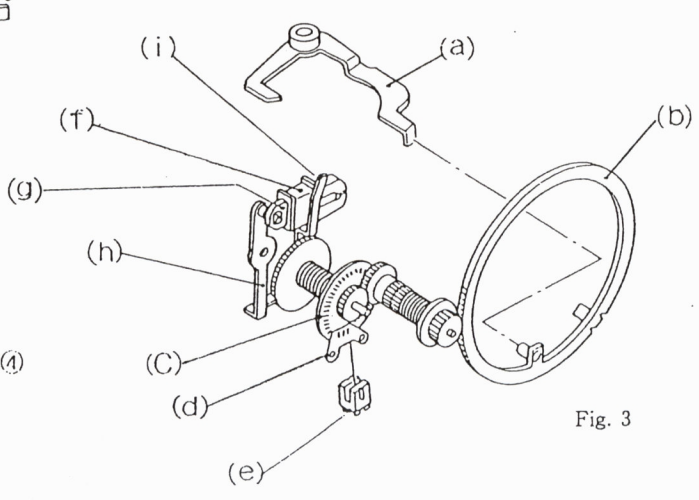


Fig. 1



Winding Mechanism

Fig. 2



Aperture Mechanism (1)

Fig. 3

Ⅶ. Mechanisms

A) Mechanical Components (Outline of Mechanisms)

The construction of main mechanisms is shown in Fig 1. ⓒ in Fig 1. is the Motor Unit for rewinding film, and is independent from other mechanisms.

The components ① to ④ are driven by the motor ⓐ which rotates forward or reverse, and this mechanism is similar to Model Contax 137 series.

The unit ① composed of gears and levers fulfils winding film, cocking shutter and charging Aperture control unit.

Power is trausmited from ① to ② by mean of rototian of the shaft ⓑ. The unit ② is located under the Mirror Box and acts to control Aperture of Lens and also to move Mirror.

The unit ③ is assembled on the side of Mirror Box, and acts to cock shutter by force driven from ①, and also up and down the mirror.

(1) Film Winding Mechnism (refer to Fig. 2)

The sequence motor employed in the model 167MT is newly designed for installation inside the film take up spool. When the shutter release button is pressed, the motor ① spins in the forward direction. The revolution is geared down through the gear train ① and transmitted through the one-way gear to the ratchet gear ②′ located under the mirror box whose rotation pushes the mirror upward.

Aperture control is completed during the mirror's upward travel and the mechanicacl lock of the shutter release is removed. The motor stops at the mirror-up completion signal. At the same time the spin lock is removed and the timing switch is turned on. In a certain short period, the shutter opens to expose the film. When an exposure is completed, the motor is turned on in the reverse direction, turning the sprocket spool to wind up the film.

During this period the Aperture magnet and the shutter are charged by the cam ①′ which is an integral part of the single turn gear. The motor also returns the mirror to its lower position and releases the lens Aperture at the beginning of its reverse rotaion.

(2) Aperture Control Mechanism. (refer to Fig. 3)

The Aperture lever (a) in the mirror drive mechanism turns the ring (b). The sensor (e) counts the pulses generated by the slits (c) and (d). At the signal given from the CPU, the magnet (f) releases the armature (g). Consequently, the stopper (h) locks the ring (b) in place and controls lens Aperture.

After an exposure is made, the winding mechanism actuates the lever (i) and puts the armature (g) back on the magnet (f). The Aperture of the take up lens is also released.

B) Shutter Functions

Theory of Operation

(1) Charged-up position (see right)

※ One end of the S Lever S is hooked by the S lever hook and the S lever pin is pushing the cam of the shutter.

※ At this stage, no current is provided to the shutter magnet, and the shutter is mechanically locked.

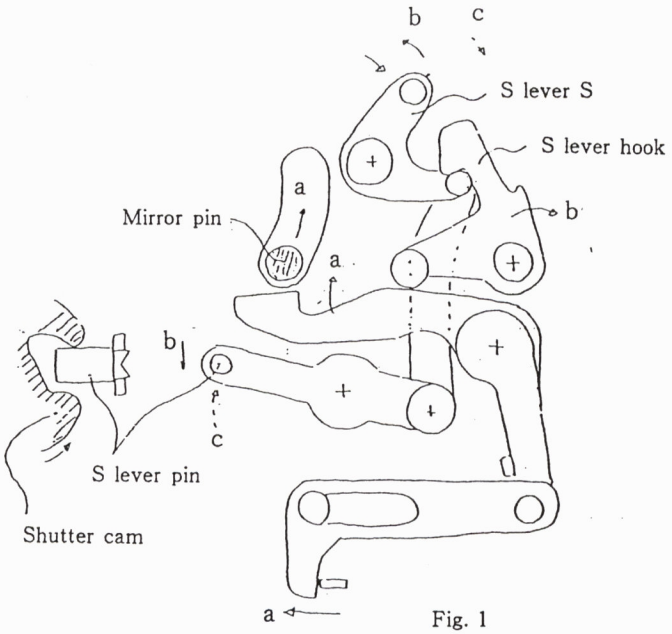


Fig. 1

(2) Actuation of the shutter release

※ As the motor start signal is released, current is provided to the shutter magnet. This prevents shutter release when the mechanical lock is released (S lever pin goes down).

Holding the other mechanism still in place, the speed control mechanism is set.

(3) Upon Mirror-up

※ As the motor spins, the gears under the mirror box are turned, and as indicated by "a←" in the above drawing, the mirror is pushed upward. (film winding will not take place due to the one-way clutch system)

(4) Release of Mechanical Lock (during first part of mirror-up)

※ As the mechanism moves as indicated "a←" in the above drawing, the hook is disengaged, as shown with "a←".

※ This takes place when the mirror is up about 10 degrees from its bottom position (20% of total swing, about 20msec. after staert of motor rotation).

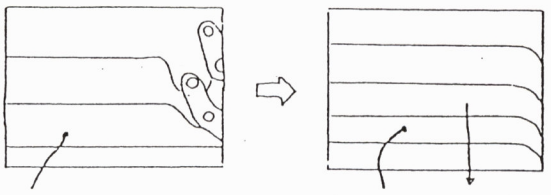
(5) Folding of the 2nd curtain (preparation for exposure)

※ S lever pin swiftly .goes down while pushing down the shutter cam (100g or less).

This triggers the 2nd curtain to go down.

※ The motions are powered by the internal spring of the shutter (shutter armature is held to the shutter magnet the by drive current).

Shutter curtains observed from the film chamber.



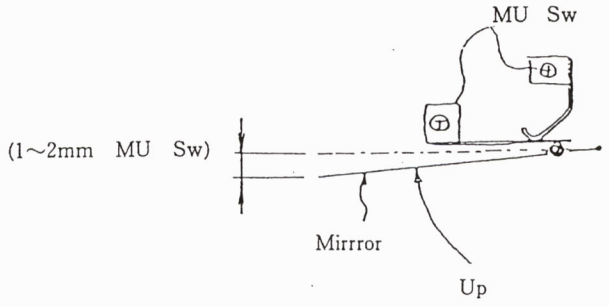
The 2nd curtain covers of the lst curtain.

The lst curtain is exposed.

The 2nd curtain is folded stored below the frame.

(6) Mirror near Upper End Position

- When the Mirror approaches its upper end position, the MU. Switch is turned on approximately 1-2mm before the end position.



(7) Mirror hits Upper End Position

- The Motor stop signal is generated 18mSec. after the MU Switch is turned on.
- The Motor stops and the Mirror is held in place until travel of the 2nd curtain is completed.

(8) Ist Curtain Start

- 30mSec. after closing of the MU. Switch, the current to the Magnet is automatically cut off and the 1st curtain begins its travel upward (speed : 6mSec. ／ 24mm).
  -start of exposure
- X-synchro contact closes within 0.6mSec. when the lst Curtain trave lis compaeted.
- X-synchro contact is integrated into the lst Curtain.
- X-synchro contact opens during film winding (shutter charge).

(9) 2nd Curtain Travel (end of exposure)

- As soon as the computed exposure time past, current to the 2nd Curtain Magnet is cut off and ends exposure when travel of the 2nd Curtain is completed. Then the Motor is switched on and the following actions (10) through (13) take place same time.

(10) Film Winding Start

- The Motor is turned on automatically 15mSec. after the 2nd Curtain Magnet is turned off.
- The Spool Sprocket Gear, which is playing loose at the time of mirror-up due to the one-way clutch, now begins to turn.

(11) Mirror-down

- As the Mirror Gears, which are holding the mirror up, begin to turn in reverse, the mirror-up lever returns to its rest position and mirror is brought down by the spring. (refer to Fig. 1)

  This action takes place right after the srart of film winding.
- The gears keep turning until film winding is completed.

(12) Shutter Charge

- o The shutter is charged and held in place by the mechanism motion indicated by "→" in Figs. 1 and 2.
- o The charge is completed when the film is advanced about 75% of a frame.
- o When the charge is completed, the S set Lever returns to its rest position. The S Lever S is hooked again to hold the shutter reiease.

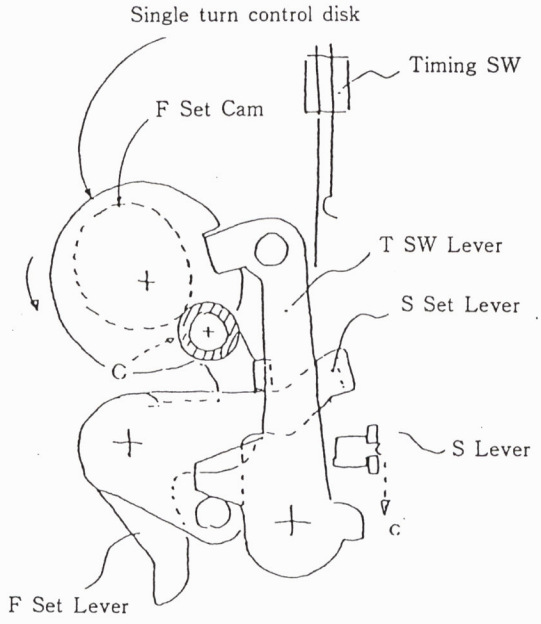


Fig. 2

(13) Charge of aperture Control

The Aperture control mechanism is chrged in the manner shown in Fig. 3 with "i".

(14) Film Winding Completion = Motor Stop (see right)

- o When one frame length of film is wound, T-SW lever falls into the groove of the single turn control disk and stops its rotaion.
- o At the same time the Timing SW turns off the Motor.

C) Film Rewind Mechanism

Film rewind actions and their sequence

(1) Operational sequence

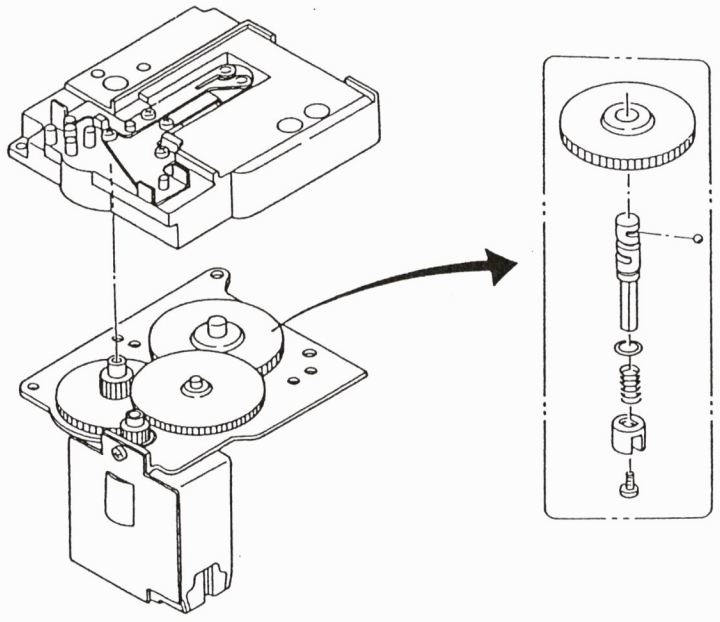
① Film is wound to its end and the sprocket comes to stop
② Motor current continues to draw and S-Friction slips.
③ After 1 second the motor current is shut off and the LCD display flashes (at 2 Hz), indicating film end. (this is just like an error condition, but the film counter can be used to correctly interpret the condition.)
Since the motor stops before completing its film advance sequence, the T-SW is not turned off (the T-SW lever is not yet engaged with the groove on the single turn control disk).
④ The motor turns on for 10mSec. in reverse direction and removes tension on the sprocket (film tension).

This permits easy operation of the Rewind lever. (The Mirror may move slightly or stop on the way, but this is by no means abnormal.)

⑤ Push in the rewind button and slide the Rewind Lever.

⑥ The contacts 1-2 of the RW-SW close.

⑦ the R-C1 shaft is pushed in and disconnects the clutch, freeing the Sprocket Spool. the RW Lever moves further and the contacts 3-4 of the RW-SW close.



① Actuation of the fork in vertical direction is driven by a steel ball as shown above.

⑧ The Rewind Motor beging to turn .The RW Shaft comes down to rewind the film.

⑨ End of rewinding -the film detection pin pops out to indicate the condition.

⑩ To wind up the film completely (not to leave the leader part on the shutter blades), the Motor turns an additional 0.5 Sec. before stopping.

⑪ The Motor turns in reverse direction to lift up the rewind shaft to allow easier to the film.

⑫ When the rewind shaft is lifted, the Motor SW-L, S turns on to indicate completion of the Shaft's lift-up sequence.

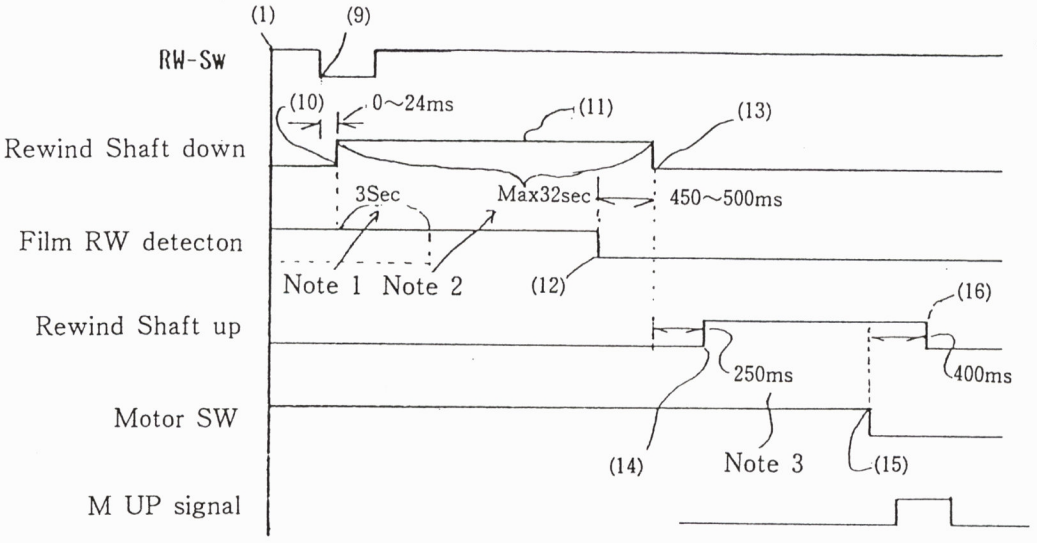
⑬ The Motor stops after turning for an additional 0.4 Sec. to completely lift up the Shaft.

⑭ The film winding Motor is turned on to complete the film advance (above atage "3") and the shutter is released once.

⑮ One frame advance sequence takes place,and the shutter is charged.

⑯ At Stage ⑭, the clutch returns to its rest position, and the spool and the Sprocket are again engaged to the mechanism.

(2) Film Rewind Sequence



Note 1 : Max. 32 Sec. If exceeded for some reason (exp. film detection switch stuck), the sequence is interrupted and an error sing is displayd.

Note 2 : In order to allow rewinding of Polaroid Instant film Polachrome, film detection is not enabled during rewinding.

Note 3 : Pause between changeover of motor direction.

(3) Special Notes on Film Rewinding

① Rewind function can be demonstrated without film

*The sequence takes place regardless of the back cover postion, open or closed. (M SW needs to be closed)

*Sequence : 5) -8), then Note 2, 9) -13)

② Battery replacement in the middle of rewinding sequence

*The rewind mark is displayed to warn the user. Restart the rewinding sequence.

③ When the Rewind Shaft is lowered unexpectedly (intentionally or by vibrations, etc.)

*The status is checked when the M SW is turned on. If the Shaft position was low, the winding continues after lifting up the Shaft.

④ When the sequence is interrupted during rewinding (to stop rewinding leaving the film leader outside, etc.

*The rewind shaft lifts up itself to allow film removal when the back cover is opened.

D) FC Unit

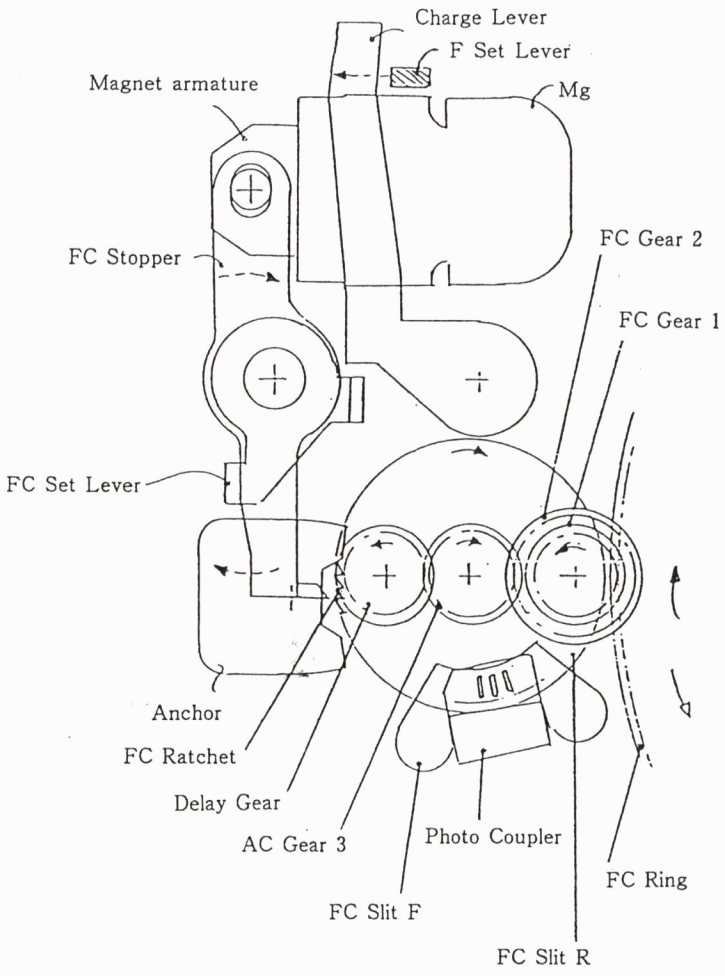
Theory of Operation

(1) Prior to shutter release (see right)

① Magnet armature is pulled by the magnet (no current is yet provided to the magnet).

② Stopper claw is disengaged from the mechanism and gears are set free.

③ FC Ring is pressed by the aparture lever in the direction indicated by the arrow (↓) and is held at its rest position.



(2) Upon shutter release

① Photo coupler LED grows

② Necessary aperture is computed based on the brightness and factors set to the camera.

③ Start signal is given to the Motor.

④ Mirror goes up as the Motor rotates. Apertue Lever is also actuated.

⑤ Following the aperture lever movement, FC Ring turns clockwise as indicated by the arrow (↑). The lens closes its aperture as the ring rotates.
In the meantime the gears with the FC Ring turn, and the FC Slits F and R interrupt the light of Photo Coupler (infra red rays) to produce light pulses.

⑥ The light pulses are then converted to electrical pulses by the photo detector. The pulses are counted umtil the predetremined value is reached.

⑦ When the pulses are counted up, current is applied to the Magnet. the Magnet armature is released from the Magnet and stops rotaion of the FC Ratchet Gear. (lens aperture is set)
The Magnet is driven by a drive pulse of about 8-10mSec.
The current is turned off afterward, but it is held in place by spring force. (Until exposure is completed and charged up again during film winding).

⑧ It takes about 60mSec. (±10mSec.) to complete the above sequence to close down 8 F-step of aperture.

⑨ Power to the Photo Coupler is turned off.

Notes :

① The delay gears and the angle control rotational speed of the AC Gear 3.

② Ancnor of the aperture actuation lever of an MM Type lens is set to 2.2 degrees per aperture.

Additional some degrees are added for the lever movement until the lens aperture blades actually start to move.

③ The FC Ring should meet the above requirements ② As the pre actuation of the FC Ring, the value larger than that specified above is assigned. However, when an MM Lens is mounted, the lever is turned to eliminate the excess.

④ The FC Slit SP and FC Pinion SP are provided to prevent backlash of the gears. They also add subtle influence on the mechanism movement.

(3) Exposure

① Within 85mSec. from the Motor start signal (Mirror-up time = MU SW closing till lst Curtain start = 30mSec.) the lst Curtain opens automatically. This calls for completion of mechanism in less than 85Sec.

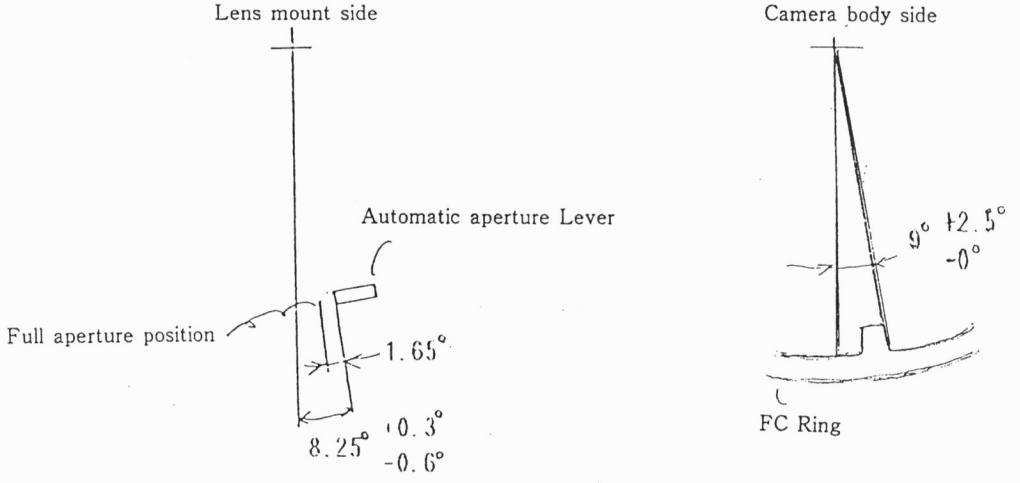
(4) Film Winding

② When an exposure is completed (2nd Curtain Mg is turned off), the Motor begin to rotate in reverse to wind up the film and to bring down the mirror.

③ During this operation, the F Set Lever, which is attached to the cam, moves to the left (←), releasing the FC Ratchet. The slit disc is set free, and the Magnet armature makes contact with the Magnet.

④ The mechanism is now returned to the atate before shutter ewlwase (refer to (1) above).

Note : F Set Lever is located between the FC Stoppr Lever and the Charge Lever. It absorbs any excess of the set amount.



Data Back (D—7)

Modale Overview

(1) Imprint date is displayed on the imprint LCD panel, by passing the light of the lamp light reaches the film.
(2) The imprint data is also diaplayed on the outside display LCD for viewing.
(3) The display is in two lines ; current calender (tear, month and day) or time (hour and minute) and alphanumeric characters up to 10 letters. The calendsr,combined with the clock function, takes care of leap year and end-of-month adjustments automatically. Characters are input through the Key switches. Up to five sets of characters can be stored in the memory.
(4) The following is the block diagram of this unit :